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Acceleration of pupils and subjects is considered a means of educating the academically gifted student. Five introductory articles provide a framework for thinking about acceleration. Five project reports of accelerated programs in Ohio are included. Acceleration is now being regarded more favorably than formerly, because methods have been developed that are less likely to cause social and emotional maladjustment than grade-skipping. A comparison of acceleration and enrichment reveals that these two programs are neither opposites nor separate concepts. Both seek fuller development of individual potential through knowledgeable teaching and quality learning.

Areas discussed are: accelerated arithmetic, advanced placement English, accelerated mathematics, advanced placement chemistry utilizing TV lectures, and the Advanced Placement Program of the College Entrance Examination Board. Each article describes a separate program for gifted students in different subject areas and on different grade levels. The overall conclusion reached is that acceleration is no longer a debatable question but an educational actuality.

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# ACCELERATION AND THE GIFTED

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Columbus, Ohio

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# ACCELERATION AND THE GIFTED

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(EDITORS)

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# FOREWORD

Ohio's program for the academically gifted is completing its fourth year. During that time it has supported a variety of demonstration projects.

Five of the projects relative to acceleration are reported in this booklet. In this way, I hope that these experiences will be shared with other educators in Ohio.

The reader will note that this monograph consists of five introductory articles in addition to the project reports. These provide a framework for thinking about acceleration and the gifted. I want to extend my thanks to those who have made this publication possible.

Dr. Sidney Pressey has been given the title "Mr. Acceleration" by educators throughout the nation. He has been in the forefront of those recognizing the educational needs of the gifted. Ohio can be proud of his contributions throughout the years.

Dr. Harry Passow and Dr. Walter Barbe are nationally known educators who have been concerned about the gifted and have provided a distinct service to Ohio's programs for the gifted.

Through the contributions of these and other nationally known educators, as well as those conducting the demonstration projects, it has been possible to continually release reports about the gifted to educators in Ohio's school systems.

E. E. HOLT
*Superintendent of Public Instruction*

# CONTENTS

Page

A New Look At Acceleration
Sidney L. Pressey ........................................ 1

Enrichment and Acceleration
A. Harry Passow ........................................ 6

Acceleration—An Educational Actuality?
Walter B. Barbe ........................................ 9

Acceleration for the Gifted—Yes or No?
Thomas M. Stephens ........................................ 16

A Study of Early Entrance to School
Alvalyn R. Larson ........................................ 17

An Evaluation of Accelerated Arithmetic
James N. Jacobs ........................................ 24

Advanced Placement In Ohio
Richard Mall ........................................ 37

An Advanced Placement Program in English
Mildred Abbott and Verda Evans ........................................ 42

An Accelerated Mathematics Program
Lawrence Hyman, Martin Preuss and James Clement ......... 48

Advanced Placement Work In Chemistry Utilizing TV Lectures
Peggy Hurst ........................................ 58

# A NEW LOOK AT "ACCELERATION"

Sidney L. Pressey
*The Ohio State University*

A few years ago, acceleration was commonly viewed with distrust by teachers and school administrators, but now attitudes are changing and for reasons to be looked at shortly. As a recent NEA report has stated, "The research testimony as to the advantages of acceleration is weighty, consistent, and continuous over several decades," (1 p. 60). But first, *what is acceleration?* It is going through an educational program more rapidly, or at a younger age, than is usual for the average child. That child starts school at the age of six, progresses a grade each year, and so enters the seventh grade at the age of twelve. If a child enters at the age of five or completes the first six grades in five years so as to enter the seventh grade at the age of eleven, he might be considered a bit accelerated.

However, some children are already reading and seem ready for the first grade at five; and their number is probably increasing because more homes now have favorable conditions for growth, and also much reading matter and both radio and television to stimulate abilities and the beginnings of reading. And some children develop mentally, physically and socially, sufficiently more rapidly than the average child during the elementary school period, that it is in accord with their real rate of growth that they cover the first six grades in five years. To hold them back to the rate of the average child would be really to retard them.

*Why not "keep them with their age group" but give them an "enriched" program?* But many such children, really physically and socially as well as intellectually more like children of their own chronological age, prefer to play with older children. The best way to enrich their education may be to let them go ahead. Another consideration is becoming increasingly important for bright children. Most of them should go on to college; and a majority of the graduates of most colleges now go on to some more advanced work—to medical school or law school or some other type of graduate training and may not finish their education until they are near thirty or over.[9] If they can somewhere along the line "accelerate" a little, they may complete their educations and begin their careers a little earlier—with less postponement of marriage and establishment in adult life. An able young physician may begin practice at 29 instead of 30 because he was allowed to complete the first six grades in five years!

*Is there not, however, risk of social maladjustment in putting a young child in with a group of older children?* Probably every teacher has known an instance where such an accelerate became shy and withdrawn and the older pupils resented his being moved in with them. Perhaps their parents did too. The important factor here is how the acceleration is brought about.

## METHODS OF ACCELERATION

Formerly the most common method of acceleration was by double-promotion, and it is usually the worst method. An occasional bright child is moved from third to fifth grade, skipping the fourth, or at least skipping a half-grade. He thus not only misses the work in the grade or half-grade skipped; he is moved from a class in which he is acquainted into one where he is a stranger and may be resented as apparently given a special favor. If there is to be skipping, it may come most easily when a child moves from one school to another, or goes from elementary school to junior high and so is going into a largely new group anyway. But usually there are better methods than grade-skipping.

One has been mentioned already: starting a bright child to school before his sixth birthday, even though he has not quite reached the age required by the school system for school entrance. Many investigations have shown that bright youngsters, thus admitted a few months earlier than the strict letter of the law would bring about, have done well in their school work and have gotten along well with the other children. Follow-ups, even to the eighth grade, have shown these initial accelerates continuing to do excellently.[12] If the law is rigidly enforced, it is sometimes possible to start a very bright and well-adjusted child, who has already begun to read, in the second grade. Little second graders do not usually note or resent such a skipping over the first grade.

Probably the best opportunity for bright youngsters to progress more rapidly than the average child comes in non-graded schools.[5] Children in the first three grades may be thrown together in a "primary pool." The teacher of such a group will have the largest portion of her group with her for three years; however, some will be ready to move into the fourth grade after only two years and the slow pupils stay there four. There are enough "fast" and also "slow" pupils that neither group feels conspicuous. The children who do get ready for the fourth grade in two years do not skip any work; they are simply helped by the teacher to progress more rapidly. It is probably desirable that grades 4-6, or the entire elementary school, be similarly dealt with.

In a large junior high school there may be rapid progress sections made up of carefully selected, bright, well-adjusted youngsters. These groups may cover the three years of junior high school in two years, or two years and a summer session. There may be similar rapid-progress sections in senior high school. Such sections do not skip any work but only cover it more rapidly, and the members are not isolated since they provide their own companionship—and are also with other youngsters in athletic, musical and other activities, as well as some classes. Follow-ups of such junior high school rapid progress sections have shown that they do as well in senior high school as youngsters equally bright who spent the regular three years in junior high, and also get along well in senior high with the other students.[3, 8] Similarly, rapid progress pupils in senior high have been found to do well in college. There they also seem to get along well with the other students. Most often instead of behaving immaturely they tend, in the more mature group and with greater responsibilities put upon them, to take on a greater maturity and responsibility than would have been the case if they had remained another year in high school—as parents often testified.

Of course, in junior or senior high school, a student may "accelerate" in only one or two subjects—may do advanced work in science, for instance. But he may then be able to pass a special college entrance examination which will give him advanced credit in that subject if he goes to college. Some able students obtain enough such credit that they enter as sophomores, or can, with a little extra work, graduate from college in three years.[4, 6, 11] Once more there is evidence that such students do well in college. And if they can thus get ahead, saving time and money, they are more likely to be able to go on into some form of advanced training, as into medicine, law, or graduate school.

In short, there are many ways by which a bright ambitious youngster may move ahead in his school work. Most do not involve missing or skipping any needed schooling. Most involve little hazard of emotional maladjustment or social isolation. The bright accelerate is one of a group which is moving more rapidly than the average child, and as acceleration becomes more common, these accelerated groups will become larger and more numerous and more accepted. Obviously there should be careful selection and guidance. Perhaps the greatest danger is that ambitious parents will urge that a child not very able or physically vigorous be put in a rapid progress section, and an occasional bright child may have problems of health or social maladjustment which make acceleration unwise. But mostly it is natural and healthy for bright vigorous youngsters to move along more rapidly than the "lock step" pace of a grade a year, which has been planned so that the child of only average ability can manage it. There should be careful selection taking account not only of ability and school work to date but also health, social adjustment, and both educational and vocational plans. A girl who plans to drop out of school after high school graduation and a boy headed for medical school are obviously in very different positions as regards desirability of acceleration. Guidance and school organization should be such that a youngster who attempts to accelerate and then thinks differently can easily shift back to an average pace and group. The attitude in school and community should be such that each child should go at his own rate, a good many faster than average and a good many slower, so that neither the accelerate nor the slow developer will feel conspicuous or subject to criticism or jealousy for his rate of progress.

*How many should accelerate?* The answer obviously involves the proportion of superior pupils in a school and their educational plans, also the extent that the school has guidance personnel and an organization facilitating progress at different rates, and the attitude of the community. In a suburb with most of the youngsters planning to go to college, there should be many accelerates, especially, if there is a local junior college or other institution to which young high school graduates can go while still living at home. *Won't the cost of guidance personnel, and of teachers for rapid progress sections or non-graded classes be prohibitive?* If children finish school a year or two sooner than average, that *saves* the school money! And it can afford to spend something on helping bright pupils progress more rapidly than the lock step. The net effect of a good program for acceleration is to save the school money and relieve congestion by getting children through sooner—no justification in itself—but a welcome bonus, if as indicated, acceleration is justified in benefits to the child.

## OUTCOMES OF ACCELERATION

As already mentioned, bright children who begin school a little early have been found thereafter to do well both in school work and relations with other children. So have such children who do the first six grades in five years, or finish junior or senior high school in two years instead of three. Moreover, students who graduate from high school young have in many investigations been found more likely to go on to college and there do well both academically and in relations with other students. Students graduating from college young are more likely to go on for some form of advanced training—now so much needed by this country, in the cold war. *Why should this be?* Obviously a bright boy who graduates from high school at sixteen is less likely, than if graduating at eighteen, to drop school for a job or marriage. One little-mentioned value of acceleration is that it tends to break up the "going steady with one's age group" which may lead to too early marriage. It has also been repeatedly found that those who finish college or advanced training early are more likely to be successful in their career. *Why this?* Probably because they then begin their career in the full flush of young manhood—healthy, vigorous, enthusiastic, still within those young adult ages when, as has repeatedly been shown, men do their very best creative work.[7]

## SUMMARY

Acceleration may be defined as going through an educational program more rapidly, or at a younger age, than the average child. Acceleration is now being regarded more favorably than formerly, because ways of accelerating have been developed that are less likely to cause social and emotional maladjustment than grade-skipping. The greatly lengthened training now needed in occupations commonly sought by bright youngsters, and the demands of the "cold war" for people with advanced training, make time-saving often desirable.

School entrance before the sixth birthday, non-graded elementary schools, summer sessions, rapid-progress sections in secondary schools, opportunities to earn advanced credit for college entrance, all facilitate progress without the educational gaps of grade-skipping, and with minimal danger of maladjustment. Much research evidence shows that these methods work well, and make it possible for more students to accelerate than formerly, with savings to them in time and often money, and savings also to the schools.

Wise acceleration has been found to save time and money for all concerned with no educational loss. Accelerated youngsters have been found more likely to go on to college and advanced training, and more likely to succeed in a career, than equally bright youngsters proceeding at the "lock step" pace.

It is thus very timely that experiments in acceleration are being undertaken in Ohio schools. It is hoped that those reported in this bulletin will be the beginning of both further research and an increased use of acceleration in Ohio.

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# ENRICHMENT AND ACCELERATION*

A. HARRY PASSOW
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Few professional discussions crop up more often—and more pointlessly—than those on the topic, "Enrichment or Acceleration?" These days the discussions spring frequently from the recognition that schools must provide adequately for their gifted or academically superior youngsters. Yet, no sooner has the theme been voiced than personal biases show through; individuals talk past one another, bandying concepts blithely, defining the two terms to their own satisfaction but not always for others. In some instances( one reason for confusion), the terms describe administrative arrangements; in others, they bracket instructional provisions.

Let's be specific: At first glance, "enrichment in the regular classroom" suggests program modifications. But a second look implies a technique for keeping children with their normal age-grade groups rather than placing them in special groups or altering the year-by-year progress through the grades. While the phrase clearly avoids such administrative arrangements as special grouping or acceleration, its prescription as to the nature of instruction in the "enrichment classroom" remains vague. One imagines, or hopes, that the gifted child will be offered differentiated activities, content, materials, and guidance which will yield the variety, depth, and breadth of learning experiences necessary to satisfy his particular needs.

Turning to the second half of our title phrase, "acceleration" has come to mean much more than grade-skipping. Any modification of a program which allows rapid progress, so that a pupil completes it in less time than usual or at an earlier age, is termed acceleration. The administrator accelerates when he permits early admission to kindergarten or first grade. The teacher's role in acceleration is many-faceted. He regulates the tempo or pace of instruction; he allots time to certain kinds of learning activities, increasing or decreasing as seems appropriate; he introduces at a lower grade content normally placed at a higher level.

But acceleration for its own sake can be a trap—lulling our anxiety to do *something* for bright ones. All instruction should suit and fulfill each student's unique nature and needs. Enrichment—which unfortunately seems aimed only at the top students—really implies the creation of a fertile, educational environment in which individual talents may flower.

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Since gifted children acquire certain learnings faster than other youngsters, they merit opportunities to progress as quickly as they can. Maturity and sophistication in specific growth areas should help determine the rate of progress rather than traditional time blocks or grade-placement of subject matter. The student's own involvement with the study area will affect the kind and quality of learning.

In the traditional teaching of reading, for example, students are urged to attain levels of word recognition, comprehension, and speech extending beyond their grade level; such familiar acceleration is widely practiced. Enrichment, as a skillful teacher arranges things, could stress acquisition of reading skills suitable for different purposes (information, appreciation, reflection, criticism, or relaxation); or it could familiarize students with a spreading range of literature; or it might widen and deepen a pupil's reading in a particular area of study.

Able youngsters who sponge up the regular program seldom need prolonged drill in arithmetic. Teachers may take them into the next grade program in arithmetic, or present different units which develop deeper insights into mathematical concepts or the nature of mathematics. A student or a small group may explore a topic first at one level of abstraction, and then in greater depth to establish new meanings or changing relationships.

In science and social studies, almost infinite possibilities unfold for digging into a topic through advanced resources—advanced in the sense of being more abstract, more complex, more demanding of a pupil's maturity, experience, or understanding. In music and art, though the neat logic of a subject sequence is missing, real possibilities abound for individuals to pioneer new territory which may be beyond the grasp of the class as a whole. A student can compare the techniques of Michelangelo or Botticelli, for example, or the uses of counterpoint by Shostakovich and Bach—if these studies have meaning for him.

Saving time in some areas of study releases time for new learning experiences in others. Acceleration (in tempo, pace or opportunities for acquiring advanced or complex ideas, skills, or information) seeks in the end to transfuse a richer, more appropriate educational experience. Both terms, enrichment and acceleration, become one—two halves of the pod holding the single kernel of more meaningful learning.

As a teacher ponders the ayes and nays of classroom enrichment or acceleration, the question loses its competitive flavor. Instead, the real problem changes to: "What kind of individualization of instruction will help enrich this particular student's learnings?" When should a child be encouraged to plunge below the surface of a new interest—getting in well over his head? When is it wiser for a pupil to sample many different areas rather than specialize in a single one? For answers, a teacher needs to go beyond his personal experience. With present developments in individualizing instruction, he must understand the research findings on multiple dimensions of learning.

If enrichment were but a clever accessory tacked on to the basic program, it would be a small perplexity. But enrichment involves a restructuring of the total educational environment to create a climate conducive to exploration, creativity, and fresh vistas of personal experience. At times, the tempo of instruction will seem to throb; at times, it will soften for reflective and painstaking thought. In some instances, the learner will work with ideas, concepts, facts, and resources which outpace those of his grade level, but his earlier experiences will have led to this and he will have accepted his need for using advanced resources.

Every good teacher tries to express well defined goals as appropriate and adequate experiences for individual students. The good teacher, seeking always to improve his own efficiency (as well as his pupils') will have to test the limits of each student's effectiveness. He will ask himself deliberately about each youngster: How does he react to having learning ceilings elevated, with no limits to learning? What kinds of skills does he lack for this kind of individual and independent learning? What special help does he need? What can I do to help him succeed?

Acceleration and enrichment are neither opposites, nor separate concepts, nor horns of a dilemma. Instead they are two channels to the same port: fuller development of individual potential through knowledgeable teaching and quality learning.

# ACCELERATION—AN EDUCATIONAL ACTUALITY?

WALTER BARBE
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Advocates of acceleration have long been adamant in their arguments in favor of this technique of providing for gifted children. In perhaps the soundest educational research of the past quarter century, results of studies have repeatedly shown superior achievement and adjustment for accelerates. Annually the evidence has mounted in favor of controlled acceleration, but acceptance of "acceleration," as it is understood by the general public and by school personnel, has not been forthcoming.

Three general observations can be made about acceleration which, although not accepted, nevertheless can be supported:

(1) Evidence is clear that acceleration, when practiced with care, does not create the problems generally attributed to it by its numerous opponents.

(2) The evidence which is being gathered today concerning acceleration is practically no different, either in quantity or quality, than that offered a quarter of a century ago.

(3) Acceleration, as a direct means of providing for the gifted, is no more popular today than it was twenty-five years ago.

Research studies continue to present evidence that acceleration is not harmful to the adjustment of gifted students, when practiced wisely. When practiced under the controlled situations concomitant with careful studies, such findings are no doubt true. Two reactions must be made, however. To imply that acceleration practiced in the rank and file school system, where there is limited psychological support and an abundance of community pressure is, or indeed can be, carefully controlled, may be a mistaken notion. Also, measures of the adjustment of accelerates are admittedly insensitive. Might it not be possible that the supposed superior adjustment of accelerates is due to their having been with older age groups so that they are actually not necessarily better adjusted but are perhaps only better test-takers of relatively insensitive instruments purported to measure adjustment?

The arguments being used to support acceleration today, admittedly sound, are no different from the arguments used a quarter of a century ago. One cannot help but wonder if the article, "The Status of Acceleration or Grade-Skipping As An Administrative Practice," by Witty and Wilkins,[1] which appeared in *Educational Administration and Supervision,* is not as eloquent and timely an appeal in favor of acceleration as any which has appeared recently.

Pressey, who indeed is and has been for many years the leading proponent of acceleration, reiterates his belief in acceleration as more than just an occasional procedure in "Educational Acceleration: Occasional Procedure or Major Issue?" [2] in the *Personnel and Guidance Journal* of September, 1962. Timesaving and money saving are still the major arguments in favor of acceleration, but Pressey does propose what he correctly refers to as "an intriguing but seemingly neglected possibility" [3]—that accelerates might be found to gain in "intelligence" were they to be matched with a group of non-accelerates.

But irrespective of the convincing and ever mounting evidence in favor of acceleration, as it is interpreted by the general public and by school personnel, acceleration is not the favored method of providing for the gifted. Just what method is favored might well be asked, but to pursue such a line of thought would be out of order in this article, other than to point out that no method has the research evidence so clearly in its favor as does acceleration.

## THE GRADE-SKIPPING NEMESIS

The major problem confronting the proponents of acceleration is that grade-skipping and acceleration are considered synonomous by most people. Grade-skipping is in at least as much disrepute today as ever, and perhaps even in more disrepute if reports can be substantiated such as those recently found in Portage County, Ohio, in which only one of one hundred elementary teachers favored grade-skipping, and two years later even she had changed her mind.[4]

Acceleration means more rapid progress toward a goal. How such rapid progress is accomplished is apparently the area of disagreement, rather than whether one is for or against acceleration. The research evidence is too clear-cut in favor of acceleration itself, as well as common sense arguments related to the early age of productivity and the need to be beyond formal schooling in order to begin producing, for one to oppose the shortening of the length of time required to complete advanced graduate work, particularly if it can be proved that in the shorter length of time the work can be learned better than in the longer period of time.

The problem then, as it appears to this writer, is actually nothing more than one not so much of basic disagreement as it is one of lack of understanding of the other person's point of view. If acceleration could in some manner separate itself from grade-skipping, this writer believes that it would be difficult to find anyone opposing acceleration.

In case there are any who would still want to include grade-skipping as the argument, let the writer make himself clear. Grade-skipping, practiced wisely, does not appear to be harmful. In theory, it may seem advisable. In actual practice, knowing when and how to practice it wisely is the problem. Grade-skipping can be used effectively, but this writer believes that it should be the exception to the rule, not common practice.

## ACCELERATION—FAIT ACCOMPLI

A great change has taken place in the schools within the past decade. The schools have dared to recognize individual differences in children, and indeed, even to recognize differences in teachers. The result has been the long over-due recognition that programs must differ for children of different abilities, and even that programs might differ and still be equally effective.

Most noteworthy in this change has been the almost complete acceptance of the long sought after "acceleration." Of course, educational jargon has not called these programs acceleration, but they provide, from the pre-school level, into the primary grade, the upper-elementary grade, the junior high, the high school and even the college, means of making more rapid progress toward a goal.

By a variety of means, incorporating many new labels and even some new ideas, students are in the years immediately ahead going to complete their formal education earlier than was allowed in the past. Only grade-skipping itself has not increased. Acceleration is indeed an irrevocable accomplished fact. Let us examine how this acceleration is being accomplished.

## COURSE CONTENT ACCELERATION

It is readily observable to parents that their children, even though they may be studying the same subjects which were offered in school a generation earlier, are learning content that was relegated to much higher grades. Witness only the first grader learning algebra and geometry as proof that content has been accelerated. Indeed, let us hope that it also has been enriched, but of most importance is that it has been accelerated. Mathematics is undoubtedly the best single example of this acceleration of course content and there is even evidence to support the belief that acceleration in mathematics is more effective than attempts at enrichment. Science must also be listed as an area in which acceleration of course content has taken place. The addition of foreign languages in the elementary school is another form of curriculum acceleration.

It must be recognized that some of the proponents of acceleration will say that even though course content acceleration is taking place, how is this acceleration in the sense that it enables students to finish their education sooner? It must be admitted honestly that the high school graduation is indeed a stumbling block to moving ahead faster, even though course content has been accelerated. But the fact remains that if the students are learning more and more at an earlier age, eventually this will lead to changes in the high school program which must at least partially include acceleration in the sense of completing high school sooner. The student who has taken a foreign language through the elementary grades will obviously be ready for a much more advanced high school course, and then either a more advanced college level course or none at all if he has completed the language as far as is necessary.

An interesting point in this area is that those advocating enrichment on a horizontal level, as opposed to acceleration which would be vertical, are becoming less adamant about horizontal enrichment in mathematics. In practice, what started out being horizontal enrichment has often become acceleration. To some extent the same thing has been found in science. In the language arts areas and in social studies this has not been found to be true, although there has been the claim that the enrichment in these areas for the gifted student is in reality only good teaching, which would be equally effective with all students.

The acceleration of course content can eventually lead to nothing else but shortening of the length of time for completion of high school. Content acceleration has not been with us long enough, and has not been effective enough, to make the pressure for more rapid completion of high school. The pressure is coming up, however, and merely adding high school sections for the gifted will not solve the problem when the material has already been learned. Soon the high schools must face this problem, as also must the colleges.

Course content acceleration is a means of accelerating the curriculum without moving the student. The ultimate goal of this will necessarily be the completion of requirements earlier, or more rapid progress toward the completion of formal schooling.

## EARLY ADMISSION TO SCHOOL

Early admission to school is undoubtedly one of the most effective means of providing for the child who is mentally, emotionally and physically more mature than his chronological age group.[5] Some of the same problems are connected with early admission as are connected with other types of acceleration, but practiced wisely, which means relying upon thorough psychological testing and evaluation, and considering all factors related to the development of the child, early admission to school has been successful.

As a means of providing for the mentally precocious young child, early admission has been very successful. It has many advantages over holding the child back, past the time of readiness for formal learning, before allowing him to learn the formal skills of reading and writing. Often such children presented so many problems in the first grade that other methods of acceleration had to be devised, sometimes unsuccessfully because of the very great difficulty which the child encountered in his initial experiences in school.

Until the recent years, it was believed by most people that children were not physically ready to learn to read even though they might possess the somewhat magical mental age of six years and six months. There has, in recent years, been many demonstrations that many children can learn to read before the usual age of six without the harmful physical effects which once were thought almost certainly to follow. Learning to read before the age of six does take more skillful teaching and more effort on the part of the child, and there is no indication that for many children there is actually any advantage in having learned to read before the age of six. The question is no longer, "can children learn to read before the age of six?", for this can be answered, "yes." The question which must be asked now is, "What is the advantage in learning to read before the age of six?" For the average child, the answer is probably that there is little, if any, advantage. For the gifted child, however, the answer may be given in terms of early admission and the need for acceleration of the type that will not necessitate his missing any of the necessary skill instruction.

## COLLEGE WORK EARLIER

There is currently much acceptance of a program whereby high school students earn credits in college courses, either by taking the courses within their high school and then receiving credit for the courses upon examination at the college, or by actually leaving high school and attending certain college classes.[6] In either of these ways, the student receives credit for the course both toward high school graduation requirements and toward college graduation requirements. The plan has been very successful and can be expected to grow. It is further evidence of the existence of programs of acceleration.

The Ford Foundation supported a program[7] which admitted carefully selected students to college early. The enthusiastic reports of the students and their parents, along with their outstanding records in college, indicate how successful such types of acceleration can actually be. The generalization that all bright students would do equally as well in college as these students must not be made, however, for not only were they carefully selected, but there was a sizeable group of them so that they had the advantage of having many others like themselves on the campus. Perhaps one of the disadvantages in attending college early is connected with how seldom it has been allowed in more recent years so that the few who do enter college early find no others like themselves. As admissions to college increase, the problem will take care of itself.

## CURRICULUM ADJUSTMENTS WHICH RESULT IN ACCELERATION

The past decade has clearly seen the development of specific trends in elementary and secondary education. Within each of these trends have been elements of the possibility of acceleration, but not because anyone either particularly believed or disbelieved in acceleration, but rather because of the ever growing belief in individual differences. Some of these trends are:

(1) Gradual diminishing of the importance of the grade levels and an increasing importance of achievement or competency levels.

(2) Shifting away from a remedial philosophy toward a philosophy of developing the particular strengths of each individual.

(3) Individualization of instruction, allowing the child to progress at his own rate, and to be evaluated in terms of his own abilities.

The ungraded school as proposed by Goodlad and Anderson[8] offers the best future for acceleration of bright students. Without ever having to skip over any grade or course work, children may progress through the primary grades faster, if they have the ability, or slower if they do not have the ability, than the customary three year rate. Never failing or skipping, but instead progressing at their own rate, is certainly much more in keeping with the modern philosophy of education which claims to provide for each individual child "in terms of his unique nature and needs."[9]

The ungraded primary school is being developed throughout the country so that in the near future the children from such programs will be reaching high school. Some of the brighter students will be accelerates.

The upper elementary grades can expect a continuation of the ungraded plan once it has established itself more firmly in the primary grades. The difficulty at this level will result in the unevenness of the achievement levels of a particular child so that it is not unlikely that the departmentalized plan will move into the elementary grades more and more.

The dual progress plan[10] offers a promising plan for the upper elementary grades whereby children are grouped partially by ability, and are allowed to progress more or less at their own rate in certain areas.

There have been some attempts to combine the three year junior high program into two years, but this has been successful only where other types of acceleration have not taken place, and in larger cities in which there are enough gifted students that groups can be taught the content of the three grades in only two years.

At the high school level, heavier loads and summer school have all been used as means of acceleration.

Regardless of the adjustments in the curriculum which allow for acceleration, enrichment is necessary. As Gallagher states, "There is no such issue as 'acceleration vs. enrichment.' *There should always be enrichment whether the child has been accelerated or not.*"[11]

## CONCLUSIONS

Acceleration is no longer a debatable question, it is an educational actuality. Often in forms unheard of only a few years ago, acceleration is being promoted as a means of allowing children to progress at their own rate. Grade-skipping, as such, is in no more favor than it has been in the years past, for more realistic and effective means of achieving the same goal have been found.

With so many types of acceleration being offered, the question does arise as to how much acceleration should be allowed. Returning to the advice of Pressey, Terman and Witty, up to two years acceleration in the total schooling of the student seems to be the answer.

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# ACCELERATION FOR THE GIFTED–YES OR NO?

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Educators often believe that one must choose between acceleration and enrichment when planning for academically gifted students. Their reasoning mistakenly implies that these are mutually exclusive possibilities—that an accelerated program can not include enriched experiences. The four demonstration projects reported in this booklet clearly show that enrichment can be a part of acceleration.

It is true, emphasis may be placed more heavily on acceleration than on enrichment or vice versa. In planning Ohio's research and service program for the academically gifted, some demonstrations dealt primarily with enrichment or acceleration. In other instances, consideration for the students precluded the type of program which was developed.

We in Ohio have learned after four years of experimentation that a variety of approaches are needed in schools if gifted children are to be adequately served. Certain considerations about each student should dictate the administrative styles to be used.

Accelerated instruction requires first of all, high academic potential as measured by tests of intelligence. Secondly, it demands high achievement. The student who is a poor or moderate achiever is not ready for academic acceleration. This *does not* mean that such a student should be excluded from a special program. It *does* mean that a different kind of program is needed for the student in order to enable him to achieve.

Early entrance to school is not desirable for every gifted child. Some children, regardless of their I. Q. scores, are simply not ready for a formal academic program at age five. The many gifted children who are ready should be permitted to begin early.

At the secondary levels, many accelerated programs have taken the form similar to the Advanced Placement Programs described in this booklet. Some bright students may not qualify for advanced work because of poor academic backgrounds or lack of interest. In such instances, the school has an obligation to recognize these children as potentially gifted and to provide the needed instruction and counseling.

There is no definitive answer to the question *acceleration for the gifted?;* for some the answer is yes. For others it must be no. But for all gifted children, we should say, "yes, there is a program for you."

# A STUDY OF EARLY ENTRANCE TO SCHOOL

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Most modern educators subscribe to the theory that school administrators have a prime responsibility toward recognition of the individual differences of their students and are aware that although most children follow a general developmental pattern, they do not progress through these steps at the same rate. In order to allow for the democratic ideal of educating each child so that he may make the best possible use of his particular capabilities, various plans of special education have been advocated, experimented with, adapted to the needs of the community, discarded, or incorporated according to the degree of success or failure.

One plan which has been put into effect in many communities is a method of early admission to school of certain underage children who do not meet the local minimum age requirements. Many feel that this plan provides an ideal method of dealing with one segment of the group of children whose learning rate is above average. The plan has an advantage over "skipping" in that a child does not risk omission of any basic fundamentals of curriculum. It reduces the chances of the bright child being bored by having to remain at home when he is ready for formal schooling and provides a natural means of placing him in contact with those closer to his own mental age than if he were to wait another year. The saving of a year may be a decided advantage to the gifted who wish to go on to post-graduate or professional training. In a 1955 study of the early entrance program in Brookline, Massachusetts, James Hobson says of this plan, "If it were practiced throughout the country it might play an important part in alleviating the present shortage in gifted scientific professional personnel."

Several disadvantages have been mentioned by those opposed to the plan. Among these are the immaturities of eye-hand coordination resulting in possible writing and drawing difficulties in the early grades. It is felt however that these inconsistencies can be minimized by an understanding teacher and that the superior reading and number ability compensates for other weaknesses. In any event, most of these children seem to have "caught up" on the writing and drawing in three or four years, while they continue to outstrip their classmates in the academic areas. It is this premise of continued academic superiority which this paper sets out to explore.

## PROBLEM

In the Cuyahoga Falls City Schools, Cuyahoga Falls, Ohio, a child may enter the first grade in September if he will have his sixth birthday by December 31st. Since 1949 an early entrance plan has been in effect whereby a five year old whose birthday is in January, February, or March, may enter school in September if he meets certain qualifications.

From 1949 to 1954, the Pintner Cunningham test was used as a screening device. Beginning in 1955, the *California Test of Mental Maturity, Pre-Primary Test* was given to all who applied, and the *Revised Stanford-Binet Intelligence Test* was then administered to those who scored high on the California.

The criterion for admission has been that the child must have a Binet mental age as much above 6-0 as his chronological age is below 6-0. Previously the tests were administered in late August and ages were computed as of September 1. Since 1958 when the summer kindergarten plan was instituted, testing has been done in June. Ages were projected to September 1. That is, a child born on January 18, tested on June 18, would have a C. A. of 5-5 and must have a mental age of 6-3. Projected to September 1, the C. A. would be 5-7 and the M. A. 6-5. A child born March 18, tested on June 18, would have a C. A. of 5-3 and must test with an M. A. of 6-5. As of September 1, these ages would be 5-5 and 6-7 respectively.

Subjective elements enter into selection through close observation of the child in both the group and individual testing situations and interviews with the parents in regard to the social, emotional, and physical maturity of the child. Since these children must compete in all areas with older children, it is felt that the total development should be superior to that of the average five year old.

Since 1949, approximately one hundred forty children have been admitted to school a year early. Of these, forty-five have left the school district, leaving almost one hundred still in the Cuyahoga Falls City Schools.

Several attempts have been made to measure the success of this plan through such devices as questionnaires to parents and teachers, evaluating reading and arithmetic achievement, and rating personal traits. The present study attempts to contrast various measurable factors concerning these early entrants with comparable data on children of like ability and age who did not start school early and are thus progressing through school a year behind the early entrants.

Statistical data have been analyzed as objectively as possible to try to determine whether children who start school at the conventional time and are among the oldest in their group have any advantage other than physical maturity over certain carefully selected children who are permitted to start school a year early.

## PROCEDURE

In order to contrast the progress of pupils who were early entrants (birthdates January 1 through March 31) with that of a normal age group, it was decided to match each early entrant with a control; i.e., a pupil of the same age, sex, and I.Q. who started school at the conventional age of six years and five, six, seven, or eight months. Those in the control group, then, are one grade behind their counterparts.

An attempt was made to find a control whose age varied no more than fifteen days and whose I. Q. score varied no more than seven points from the early entrant's. Students who were born from 1945 through 1948 were matched on their Pintner-Cunningham scores. For those who were born in 1949, it was necessary to match on the basis of 3rd grade California scores. Since the early entrants had the Pintner Cunningham at first grade level and the control group had the *California Test of Mental Maturity* the following year as their first grade test, it was not plausible to attempt to match the two different test scores.

The I. Q. score used for the early entrants now in fifth, sixth, or seventh grade, was from the *California Test of Mental Maturity, Short-Form, Pre-Primary,* administered during the last week of August before the beginning of first grade. In the case of early entrants now in fourth grade or lower, this test was administered during the third week in June, preceding school entrance. For the controls, the test used was the *California Test of Mental Maturity, Short-Form, Primary,* administered in October, approximately one month after beginning first grade. In all cases this was presumably the child's first experience with a group test of academic aptitude. In four cases where it was not possible to match on group scores, *Stanford-Binet, Form L,* scores were used.

**Table 1—I. Q. Scores Used in Matching Pairs**

| | Boys | Girls | Total | I.Q. Range | Mdn. I.Q. |
|---|---|---|---|---|---|
| Early Entrants ............ | 19 | 36 | 55 | 98-141 | 120.85 |
| Control Group ............. | 19 | 36 | 55 | 104-139 | 119.97 |

For many of the early entrants it was impossible to find controls with high enough I.Q. scores. Fifty-five pairs were matched, making a total of one hundred ten pupils involved in the study in grades two through twelve.

Since 1955, the Stanford-Binet has been administered as part of the screening procedure for early entrance. Those admitted prior to 1955 did not have Binets at the time of entrance, but did have them as a follow-up during the school year 1954-55. Therefore, Binet scores are available for all early entrants. Many of these students had Binets in the sixth grade as part of the screening procedure for the enrichment program, but the scores used in Table 2 are derived from the first Binet given.

**Table 2—Stanford-Binet Scores of Early Entrants**

| Boys | Girls | Total | Range | Mdn. I.Q. |
|---|---|---|---|---|
| 19 | 36 | 55 | 111-156 | 124.34 |

**Stanford Achievement Tests**

The *Stanford Achievement Test* is administered routinely every April to all students in the school system, grades two through eight. Test results of the children in the study were analyzed by matching the scores of the early entrants against the corresponding year for the controls. For example, a fifth grade early entrant and his fourth grade partner would both be matched on their end of third grade scores. Students from ninth grade up were all matched on eighth grade scores—the last year they took the test. Only forty-five pairs could be used in this comparison since the youngest control group was in first grade last year, and achievement tests were not given.

### Grade Averages

The fifty-five pairs were also compared on grade averages of their academic subjects. These were computed on a point basis with an A equal to 4 points, B to 3 points, C to 2 points, D to 1 point, and an F, zero. Yearly averages were used for high school grade point averages and the second semester grades were used for the elementary and junior high school. In the case of the controls, the grades of Spring, 1961 were used. For the early entrants, 1960 grades were used so that they would be comparable at the same grade level.

### Personality Tests

*California Tests of Personality, Form AA,* were administered to the one hundred ten subjects during February, 1962 and profile sheets were prepared showing percentile ranking in the areas of Personal Adjustment, Social Adjustment and Total Adjustment. For the early entrants, Primary forms were used for grades two through four, Elementary for grades five through seven, Intermediate for grades eight through ten, and Secondary for grades eleven and twelve. Corresponding forms were used for the controls so that each pair, being the same age, took the same test, even though they are in different grades.

### Eligibility for the Enrichment Program

Another measure of school progress is eligibility for the enrichment program in the junior and senior high schools.

Criteria for participation in this program include an individual psychological evaluation yielding results in the range of the very superior and achievement scores and grades above a prescribed limit. Teacher conferences are held in an effort to determine each student's emotional and social maturity. The screening and selection process takes place at sixth grade, although new students may be accepted at any time in the higher grades.

A comparison was made between the early entrants and the control group to see how many who reached sixth grade were selected for the enrichment program.

### Anecdotal Reports

Cumulative folders of each student contain, along with other records, anecdotal reports describing school adjustment, as well as comments on problems, behavior, and the child's relationship to his peers. These comments were copied onto cards and an effort was made to analyze these for positive or negative content. This is probably the least objective of the measures studied. Several folders held no teacher comments at all; some were cursory where there were apparently few problems encountered; and some were contradictory with some teachers having some favorable and some unfavorable comments about the same child. The descriptions mature and immature were used about children in both groups, suggesting that an advantage of chronological age does not necessarily guarantee maturity. The comment, "seems bored—needs extra work to keep him busy," appears in the files of both groups but seems more prevalent among the controls. Poor handwriting and motor coordination were more frequently noted among the early entrants in the lower grades.

Due to the lack of uniformity and the contradictory nature of so many records, it was felt that these data could not be objectively analyzed, nor any reasonable conclusion be reached.

## RESULTS

### Stanford Achievement Tests

The *Stanford Achievement Test* consists of a series of subtests in various academic areas and yields a battery median purporting to measure growth in curriculum skills as well as a comparison with national norms.

The median was computed for both the early entrants and the controls at each grade level. As previously noted, all early entrants, 10th grade and over, and all controls, 9th grade and over were matched on 8th grade achievement, the last grade at which the test was given. Scores were from tests given in the month of April.

The medians of both groups were above national norms at each grade and were not significantly different from each other. The median margin above grade level for the early entrants was 1.7 and for the controls 1.7, suggesting that the achievement of the early entrants did not suffer because they were a year younger than the controls at the time of testing.

### Grade Averages

Means and standard deviations were computed for the grade averages of the two groups. As mentioned before, an A was equal to 4 points, a B to 3, a C to 2, a D to 1, and an F to 0. Only grades for academic subjects were used. Omitted were grades in spelling, writing, music, art, typing and physical education.

With a C considered to be an average grade, both groups appeared to be doing good work in school, averaging 3.2, or better than B. It should be noted that thirty-nine of the early entrants and thirty-five of the controls were averaging B or better, while 21.8% of the early entrants and 25.5% of the controls had straight A's.

### California Tests of Personality

Since standard scores differ on the various levels of the Personality Test, it was necessary to use percentile scores in the statistical study.

Means were computed for the early entrants and controls in the three areas measured on the test: Personal Adjustment, Social Adjustment, and Total Adjustment.

The calculated critical ratios were so small as to be statistically insignificant. It appears that on the basis of these test results, adjustment as measured on a personality test is not affected adversely or otherwise by early entrance.

### Enrichment Program

Of the twenty-seven pairs of students in the study who reached the grade level to be considered for eligibility in the enrichment program, twelve or 44% of the eligible early entrants and nine or 33% of the eligible controls were actually selected.

This comparison is interesting because although emotional and social maturity are weighed at the time of school entrance, early entrants are not selected for "giftedness." The superiority of the early entrant group in this category seems to indicate that the careful selection of five and a half year olds has value. Six years later a large percentage are demonstrating enough motivation, high grades and achievement, and favorable teacher recommendations to be placed with a group normally comprising about 12% of the school population.

## CONCLUSIONS

In all areas measured and analyzed, differences between the two groups, early entrants and controls, are negligible. This conclusion would lend itself to either of two implications.

One implication might be that there is no particular value to be gained by the early entrance plan. Those who entered school at the conventional time appear to be doing as well as the early entrants in all areas mentioned and have the advantage of another year's maturity and physical growth and of being among the oldest in their grade. One might assume from this study that they are doing the same quality of work that they would have done had they started a year early.

Another implication would be that the early entrants appear to be doing as well in school as if they had waited another year to start, and have the advantage of being a year ahead of many in their age group. One might assume from this that they have not been penalized academically or in terms of personality test results by starting school a year early.

One conclusion that could be drawn is that the early entrants are progressing at a faster pace than their classmates in spite of being a year younger. The control group appears to be progressing at the same rate as the early entrants in spite of being a year older. For example, one might expect a child of high ability, who is older than his classmates, to be achieveing at a higher level than a child of like ability who is younger than his classmates. This does not appear to be true, and both groups seem to be functioning according to their ability level, somewhat nullifying the effects of the age difference.

It should be noted again that a main factor in limiting the size of the sample was the inability to find controls in the proper age classification with high enough I. Q. scores to match with the early entrants. This means that some of the strongest early entrants could not be included in the study.

## IMPLICATIONS

Personal attitudes, values, and feelings enter into the selection process and even into the evaluation of whether the plan has been successful in individual cases. Such intangibles are largely immeasurable.

In a family where athletic prowess and physical strength hold much importance, a boy might be unhappy being younger than his peers. In another family, where intellectual stimulation is a part of the daily pattern, a child would probably be more comfortable with a peer group closer to his mental level.

It is possible that later events may affect the evaluation of the decision. An understanding teacher who is familiar with patterns of child development can make the underage child comfortable in his surroundings and can promote a motivation toward education that will remain with him throughout his years in school. A teacher who is unsympathetic to the program and impatient with any display of immaturity can contribute to an unsuccessful school experience. Differences in teachers influence attitudes of other children as well, but perhaps take on added importance with these children who may be more sensitive and vulnerable than the average child.

Careful selection methods seem to be essential in determining which children have the aptitude, ability, and stability to participate in this form of acceleration. Beyond that, cooperation and understanding of parents and teachers are vital in determining whether the child will profit from the experience.

In view of the over-all success of the program as a means of providing for a group of children who display early school readiness, the Administration plans to continue the early entrance procedure with preschool testing as described in this report.

# AN EVALUATION OF ACCELERATED ARITHMETIC

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In the school year 1959-60 a program of arithmetic acceleration was begun in certain elementary schools in the Cincinnati Public Schools. The program was planned as a five-year experiment and was to begin in grade three and extend through grade six.

Briefly, the program of arithmetic acceleration consists of encouraging a pupil to complete the arithmetic course content of the grade level as rapidly as possible. He then studies the arithmetic of the next higher grade, using the appropriate supplementary textbook; thus, he is permitted to accelerate. This acceleration is not conducted entirely on an individual basis. In practice, most teachers identify sub-groups of able students within their classes and work separately with each sub-group. Even though a pupil may accelerate in a given grade, he is required to start with the basic textbook when he enters a new grade. In this way, accelerated pupils are required to review that portion of the text containing the material covered the previous year. This review is done very rapidly.

The instructional adjustments necessary to cope with the accelerated program were the responsibility of a supervising teacher who was appointed specifically for this task. This supervisor has worked closely with the 125 teachers involved in the study.

By conducting such a program for four years starting in grade three, it was thought that the accumulated acceleration might amount to as much as five years of course work given in a four year period. While it was felt that acceleration would have intrinsic value, it was also thought that pupils who could accelerate a full year might be sufficiently prepared to continue the acceleration in the junior and senior high schools. If such acceleration could be achieved, it might then be possible to complete the traditional four years of high school mathematics by the time the student completes his third year of high school. Some pupils then could study some type of higher mathematics in the twelfth grade.

Several questions may be raised with respect to the program of acceleration. Certainly the most important question is whether pupils can raise their level of arithmetic achievement above normal expectation without concomitant harm to other aspects of the curriculum. A second question is the feasibility of forming sub-groups within a class for arithmetic instruction. While this grouping is commonly done in reading instruction, it is not so often practiced in arithmetic. Other questions were raised with respect to acceptance of this program by pupils and teachers and whether undesirable pupil behavior might result from the program. Finally, there were concerns over the articulation of the accelerated arithmetic elementary program and the junior high school mathematics program.

Several of the questions raised above were discussed in the 1960-61 report of this study. For example, surveys were made of the behavior and attitudes of accelerated pupils, and these were compared with similar responses made by non-accelerants. Teacher attitudes toward the program also were surveyed. In general, the findings were favorable toward the accelerated program.

This report focuses attention on two major questions: (1) the extent of arithmetic achievement by accelerants in comparison to the achievement of non-accelerants, and (2) whether the accelerated arithmetic program results in better preparation of pupils for two types of seventh grade mathematics curricula.

## THE EFFECTIVENESS OF ACCELERATION IN INCREASING ARITHMETIC ACHIEVEMENT

Several types of achievement comparisons, under varying conditions, are contained in this section. Ideally, a group of pupils, all of whom have the potential for acceleration if given the opportunity to accelerate, would be identified. This group would then be divided randomly in half, with one-half permitted to accelerate and the other half given regular instruction. Such an arrangement would at least eliminate bias resulting from extraneous factors selectively associated with pupils who are accelerated or non-accelerated. Unfortunately, these experimental conditions were not possible; therefore, several types of comparisons were made, each defining a different control situation and each attempting to reduce possible bias in a different way.

### Comparison 1.

Control pupils or non-accelerants are defined as pupils who did not accelerate because they were judged incapable of doing so. Thus, acceleration was denied to the control pupils not out of choice but because of their relatively low achievement. Experimental pupils, or accelerants, are defined as pupils who complete the course requirements in arithmetic in their respective grade levels and complete a pre-selected amount of material in the succeeding grade.

The accelerated program was offered in twenty-three schools. It is to be expected that in some classes all pupils would achieve acceleration; in other classes only some of the pupils would accelerate; and finally, in some classes no pupils would accelerate. This situation provided an interesting and convenient opportunity to study the effects of homogeneous and heterogeneous grouping, as well as acceleration, on pupil achievement.

With these objectives in mind, a random selection of 18 of the 23 schools involved in acceleration were tested in grades four and six. The Arithmetic Concepts and Problem Solving subtests of the *Iowa Tests of*

*Basic Skills* (ITBS) *Form 1,* were administered in June, 1961, as the criterion measure. Since the ability and achievement levels of pupils in these schools are rather high, the fifth and seventh grade levels of the ITBS were administered to the fourth and sixth grade classes, respectively. In addition, scores of the *Kuhlmann-Anderson Test* and the *Lorge-Thorndike Intelligence Test, Verbal Battery,* were obtained for the fourth and sixth graders, respectively. All pupils were classified into one of the following groups: accelerants in homogeneously accelerated classes ($E_1$); accelerants in mixed classes ($E_2$); non-accelerants in homogeneously non-accelerated classes ($C_1$); and non-accelerants in mixed classes ($C_2$). Analyses were based on a random sample of 100 pupils in each of the four classifications at each grade level.

By statistically controlling for the effects of mental ability on pupil achievement, it was thought that at least some of the bias inherent in these comparisons could be eliminated. Statistical control of I.Q. was accomplished through the use of a one-way classification analysis of covariance for each grade level studied.

The analysis consisted of three steps:

(1) Test the validity of the assumptions of homogeneous variance and regression.

(2) If Step 1 proves tenable, make over-all F-test for differences in treatment means.

(3) If a significant F-ratio is obtained in Step 2, conduct t-tests for each pair of means in order to determine significance of differences.

## Results of Fourth Grade Comparisons

The covariance analyses of the Concepts and Problem Solving tests demonstrated homogeneous variance and produced significant F-ratios among the four adjusted means. As a result, six separate t-tests, one for each pair of means, were made for each subtest in order to identify differences which are significant.

All comparisons involving experimental and control groups show a significant difference favoring the accelerants. Both comparisons of $E_1$ vs. $E_2$, however, lacked significance even though in both cases the difference favored the accelerants in homogeneous classes. In the Concepts comparison of the $C_1$ vs. $C_2$ groups the difference of 2.59, favoring the non-accelerants in mixed classes, is significant, although the same comparison for Problem Solving lacks significance.

The mean I. Q. scores of both experimental groups are considerably higher than the corresponding means of the two control groups. This difference reflects the correlation between mental ability and arithmetic achievement, since brighter pupils tend to be associated with acceleration. The means of the Arithmetic Concepts test even after adjustment, i.e. after cancelling out the effects of mental ability, show sizable differences between experimental and control groups. The Arithmetic Concepts test shows mean grade equivalents of 6.8 for the $E_1$ group; 6.7 for the $E_2$ group; 5.2 for the $C_1$ group; and 5.6 for the $C_2$ group. Since testing occurred early in June, the norm would be 4.9. It appears, therefore, that all four groups achieved above the norm in Arithmetic Concepts. In relation to mental ability, these grade equivalents, particularly for the experimental groups, are considerably above the norm. For example, the mean I. Q. scores of both experimental groups (116.23 and 115.30) are about one standard deviation above the mean, or approximately at the 84th percentile. The grade equivalents of 6.8 and 6.7 for the $E_1$ and $E_2$ groups, respectively, are equivalent approximately to the 99th percentile.

The means and grade equivalents of the four groups on the Problem Solving test show approximately the same results as the Concepts test; for example, the means of both experimental groups, even after adjustment, are considerably higher than either control group. The major difference between the Problem Solving and Concepts test results is that the Concepts test showed generally higher mean grade equivalents than the Problem Solving test. Even here the mean grade equivalents of both experimental groups are considerably above expectation in relation to their mental ability level.

### Results of Sixth Grade Comparisons

The same analytical procedures used for the fourth grade data were applied to the sixth grade data. Analysis of the Problem Solving data showed inconsistent regression among the four experimental and control groups.

At most levels of I. Q. represented, the experimental groups achieved more than the control groups. Testing for significance of difference at the total group mean I. Q., a significant F-ratio is obtained among the four adjusted means. Both E groups are much higher in achievement than either C group. This difference becomes larger as the I. Q. score increases.

Whether the inconsistent effectiveness of acceleration, depending on mental ability, is intrinsic or extrinsic is not known. Since this phenomenon was not noted in either fourth grade analysis nor in the remaining sixth grade analysis, it is believed to be extrinsic. In either event, there is little doubt regarding the superiority of acceleration at least in the above average ranges of mental ability.

Analysis of the Arithmetic Concepts subtest was straight forward, with the adjusted means showing differences. A summary of the results of the sixth grade testing follows.

The test results are very similar to the fourth grade results: the I.Q. score means of both E groups are higher than both C groups; the adjusted criterion means of both E groups are considerably higher than both C groups; the mean grade equivalent differences between the E's and between the C's are relatively small. The total grade norm for the test is 6.9, since testing occurred early in June. The grade equivalents of the Arithmetic Concepts test for $E_1$ and $E_2$ groups are 1.9 and 1.6 years above the norm, respectively. Similarly, the grade equivalents of the Problem Solving test are 1.5 and 1.1 above the norm for the $E_1$ and $E_2$ groups, respectively. Relating achievement in Arithmetic Concepts with expectation based on mental ability, both experimental groups achieved above expectation. The Problem Solving grade equivalents of 8.4 and 8.0 for the $E_1$ and $E_2$ groups are not significantly above expectation. This finding, which was noted also in the fourth grade analysis, is rather important, for it reflects the instructional emphasis of the accelerated program. The instructional program emphasizes basic concepts and understanding of the subject to a greater extent than it emphasizes computational skills.

All differences involving an E group versus a C group were significant and favored the E groups. Comparison of $E_1$ vs. $E_2$ and $C_1$ vs. $C_2$ lacked statistical significance, thus indicating that grouping homogeneously or heterogeneously had no significant effect on achievement. In spite of this lack of statistical significance, the adjusted $E_1$ mean of 29.50 is higher than the Adjusted $E_2$ mean of 28.05, and the adjusted $C_2$ mean of 23.61 is higher than the adjusted $C_1$ mean of 22.29. The direction of these differences supports the finding of the fourth grade analysis. Homogeneous grouping apparently is an advantage to accelerants but a disadvantage to non-accelerants.

### Comparison 2

In this comparison the same sixth grade accelerants used in Comparison 1 were again subdivided by the type of class from which they came; i.e., homogeneous ($E_1$) or mixed with non-accelerants ($E_2$). Control groups were formed by selecting pupils from the same school and the same grade but who were in attendance two years previous to the experimental groups; i.e., before the accelerated program began. One control group was matched with respect to ability and sex, in addition to grade and school, with the accelerants from homogeneous classes ($C_{E1}$). A second control group was matched on the same variables with accelerants from mixed or heterogeneous classes ($C_{E2}$). The advantages of this comparison over the previous one are that both experimental and control pupils may be viewed as potential candidates for acceleration and probably subjected to teaching under similar conditions. A limitation lies in the possibility that some systematic effects, operative two years ago but not at present, or vice versa, may be the cause of possible differences. It is not believed that such a bias exists.

The criterion test used for this comparison is the Arithmetic Reasoning subtest of the *Stanford Arithmetic Test, Advanced Battery, Form L,* administered to the sixth grade accelerants in December, 1960, and Form J to the control groups in December, 1958. This test is a regular part of the testing program in the Cincinnati Public Schools and therefore was not administered solely for this experiment. It is significant to note the administration time of December. This is a disadvantageous date for comparison because if acceleration does increase achievement, then the achievement differences with non-accelerants would be greater at the end of the year than in the middle since its benefits would be cumulative.

In addition to the comparisons of arithmetic achievement, comparisons were also made of reading achievement. This comparison, obtained from the same groups defined above, was made in order to determine whether the accelerated arithmetic program may have caused any deficiencies in reading achievement. It also serves to provide a check on the comparability or similarity of the experimental and control groups. Since no apparent changes have occurred in the reading program, there is little reason to believe that reading achievement would be significantly different over the two year period unless, of course, accelerated arithmetic had a depressing effect on reading achievement.

### Results of Arithmetic Comparisons

The arithmetic test results were compared using a one-way classification analysis of covariance controlling for mental ability. The conditions underlying the validity of the analysis were made and found tenable.

The equality of the $E_1$, $C_{E1}$, mean I. Q. scores and the $E_2$, $C_{E2}$ mean I. Q. scores reflects the matching that was done. The raw score Stanford Test means, unadjusted and adjusted, of both experimental groups are higher than their respective control groups' means. Translating the unadjusted means to grade equivalents shows the $E_1$ grade equivalent of 9.4 to be 14 months higher than its control group ($C_{E1}$) and the $E_2$ grade equivalent of 8.1 to be 3 months higher than its control group ($C_{E2}$).

It is interesting to note that the sixth grade $E_1$ and $E_2$ mean grade equivalents for Arithmetic Concepts in Comparison 1 were 8.8 and 8.5, respectively. These were the results of the *Iowa Tests of Basic Skills* administered in June. These same groups, tested six months earlier with the Stanford Advanced Battery, Arithmetic Reasoning, gave grade equivalents of 9.4 and 8.1 for the $E_1$ and $E_2$ groups, respectively. Thus, the $E_1$ group scored 9.4 in December and 8.8 in June, while the $E_2$ group more reasonably scored from 8.1 to 8.5. Total group grade norms were used for both tests. The discrepancy may be a function of differences in what the two tests are measuring, and/or the standardization population and norming techniques. Since the concern of this report is with group differences on the same tests, this discrepancy is of little concern.

The over-all F-test for adjusted group mean differences was found to be significant, thus, separate tests of significance were made. These comparisons were made between each experimental group and the corresponding group.

All the differences were significant, except for the $C_{E1}$ vs. $C_{E2}$ comparison. There is no reason for this comparison to be significant since both control groups are samples from the same population. The fact that the $C_{E1}$-$C_{E2}$ difference lacks significance gives more confidence to the conclusion that achievement differences between experimental and control groups are due to differences in the accelerated program.

The significant difference favoring the $E_1$ over the $E_2$ group shows again that homogeneous grouping of accelerants is more advantageous to their achievement than is the situation where they are mixed with non-accelerants.

### Results of Reading Achievement Comparisons

The Advanced Battery of the *Stanford Reading Test* was administered at the same time and to the same pupils as the arithmetic test. By maintaining the same pupil classifications ($E_1$, $E_2$, $C_{E1}$, $C_{E2}$), even though the "type of class" distinction has no meaning in reading class, it was possible to compare the reading achievement of these same four groups. Exactly the same analysis was used as that described for the arithmetic test.

The adjusted raw score means of the two experimental and two control groups ranged from 30.57 to 31.58. The over-all F-ratio for differences among means was too small to conclude that true differences in reading achievement existed among any of the four groups.

### Comparison 3

In the first two comparisons, accelerants were defined as pupils who completed the course work at a given grade level and studied at least a prescribed amount of material in the succeeding grade. Since the accelerated program began in 1959-60, pupils who began acceleration in grade four of that year, and who were sixth graders in 1961-62, had the cumulative effects of three years of acceleration. Some of the present sixth graders, however, did not accelerate until grade five, simply because they did not meet the standards for fourth grade acceleration. Finally many of the present sixth graders achieved acceleration only in the sixth grade.

In this comparison, sixth grade pupils in the experimental schools during 1961-62 were identified as beginning acceleration in grades four, five, or six. A random sample of fifty pupils in each classification was selected for analysis.

On the assumption that pupils in the upper 30 per cent of academic ability represent potential accelerants, a random selection of fifty pupils with I. Q. scores of over 110 was made from among ten non-accelerated schools. These ten control schools came closest to being matched with the experimental schools in terms of location and socio-economic status.

The advantages of this comparison over the previous two are: both experimental and control groups are in attendance during the same year; the control group probably may be viewed as potential accelerants; the effects of successive years of acceleration may be gauged. The disadvantage lies in the lack of control over possible systematic school and instructional differences between the experimental and control schools.

The criterion test was the same as used in Comparison 2, the Stanford Advanced Battery, Arithmetic Reasoning Test, administered in December, 1961. Since few pupils are able to begin acceleration before January, the sixth graders who accelerated only in grade six, were tested before they began acceleration. Of course, the latter pupils were not identified until later (June, 1962).

A one-way classification analysis of covariance again was used for controlling I. Q. differences among groups. The following summarizes the definitions of the four groups analyzed:

$A_3$—Sixth grade pupils in their third year of acceleration beginning in grade four, 1959-60.

$A_2$—Sixth grade pupils in their second year of acceleration beginning in grade five, 1960-61.

$A_1$—Sixth grade pupils beginning their first year of acceleration, 1961-62.

NA—Non-accelerated sixth grade pupils in non-accelerated schools where mental ability is sufficiently high to assume that they are potential accelerants.

It should be noted that the $A_1$ and the NA groups are different not in the sense that the $A_1$ group is accelerated and the NA group non-accelerated, since neither group has met the definition of acceleration at the time the criterion test was given. The difference lies in the fact that the $A_1$ group had about completed their sixth grade work by the time the criterion test was given while the NA group had only partially completed the sixth grade work.

**Results**

In spite of the I. Q. score differences among groups, the adjusted criterion means show the same order as the unadjusted means with the $A_3$ mean highest, followed by $A_2$, $A_1$, and NA. In view of the early December testing date, the test norm for sixth graders is 6.3. The grade equivalents range from 8.0 to 9.6, or from between 17 to 33 months above norm. Of course, a large amount of this is due to the high ability levels of the groups.

A significant F-ratio was obtained when the four adjusted means were tested for significance of difference. Consequently, t-tests for determining significance of individual pairs of means were made.

The data showed all comparisons to be significant except the $A_3$ vs. $A_2$ comparison. Most importantly, all three accelerated groups were significantly higher in achievement than the non-accelerated group. The significant difference between $A_1$ and NA is not due to the $A_1$ group actually beginning seventh grade work, since the criterion test was administered before they began. Rather, the difference is due to the fact that the $A_1$ group had almost completed the sixth grade work by the time the criterion test was given, whereas the NA group was not quite halfway through. This difference was equivalent to about four months of achievement.

Interpretation of the similarity of $A_3$ and $A_2$ leads one to believe that it makes no difference whether pupils begin acceleration in grade four or grade five. Several reasons for this may be suggested. Sixth grade teachers, faced with accelerants beginning in both grade four and grade five may have given similar instruction to both groups. This possibility is even more plausible when classes also contain non-accelerants. Secondly, the lack of difference may be a function of test validity in the sense that the test may be capable of detecting achievement differences up to a certain point, but not beyond. This hypothesis is supported by the fact that the Stanford Advanced Battery is normed on grades seven, eight, and nine. A third possible explanation is that the $A_3$ and $A_2$ groups initially may not have been so different in fourth grade achievement. In the program's first year, teachers were most cautious of accelerating pupils. Thus, many fourth graders who could have accelerated did not do so until grade five. In grade five, when given the opportunity to accelerate, the $A_2$ group caught up in achievement with the $A_3$ group. Further investigation of this phenomenon will be made later.

### Comparison 4

The preceding three comparisons have considered the pupil as the sampling unit. This comparison is similar to Comparison 2 in that 1959 (pre-acceleration) achievement is compared with 1962 achievement. The difference is that this comparison involves school statistics (accelerants and non-accelerants) from all accelerated schools.

It is reasonable to assume that if the accelerated arithmetic program increases achievement, then these increases may be reflected by differences in over-all school achievement before and after acceleration began. Pre- and post-acceleration achievement will be compared at the three quartile points of the achievement distribution of each of the twenty-one accelerated schools. It is expected, of course, that most differences will be detected at the third quartile point, since accelerants represent the highest achievers. If a generalized interest in higher arithmetic achievement has been engendered by the program, it is possible that the second quartile points may show some increase, even though these pupils are not accelerants. It is unlikely that the first quartile comparisons would show many increases.

The criterion test is the *Stanford Arithmetic Test, Intermediate Battery,* administered in February of 1959 and 1962 to all sixth grade classes. The 1959 to 1962 quartile differences were tested for significance using a chi square analysis.

At the first quartile, the results show eleven schools gained in reasoning achievement, seven of which were significant, while ten schools decreased, of which five were significant. Computation gains and losses were similar except that four gains showed significance while only one loss was significant.

At the median, a few more schools showed gains, thirteen in reasoning and sixteen in computation. There are proportionately more significant differences favoring gains over losses at the median than at the first quartile.

The third quartile comparisons show even more schools with gains, seventeen in reasoning and eighteen in computation. Ten schools on each subtest showed a significant gain.

If no achievement change occurred, one would expect about half of the schools to increase and half decrease in achievement. This situation is generally true at the first quartile, but it begins to change at the median.

favoring gains, and becomes most pronounced favoring gains at the third quartile point. On the basis of these data, it appears that the accelerated program has increased the achievement of at least the upper 25 per cent, and probably the upper 50 per cent, of pupils.

**Conclusions to Part 1**

Four types of comparisons have been made to establish the effectiveness of the accelerated arithmetic program in significantly increasing achievement. Different approaches to the problem have been made due to the absence of a true control group against which to measure differences. The conclusions to Part 1 are as follows:

(1) Accelerated pupils achieved significantly higher when compared with:

   (a) non-accelerants of similar mental ability in the same schools and grades and during the same school year, but who did not meet the standards for acceleration.

   (b) non-accelerants of the same sex and mental ability from the same grades and schools but who were in attendance before the accelerated program began in 1959, and who probably would have accelerated if the program were in effect.

   (c) non-accelerants of equal mental ability from schools not participating in the accelerated program and who probably would have accelerated if the program had been administered in their schools.

(2) Arithmetic achievement on a school wide basis was higher after acceleration than before it began. The increases were most pronounced at the third quartile point and present to some extent at the median. This gain suggests that the program may be favorably influencing achievement of non-accelerants.

(3) The accelerated arithmetic program appears to promote understandings and concepts to a greater extent than computational skills, although the latter is by no means sacrificed.

(4) The accelerated arithmetic program has no measurable depressing effect upon reading achievement.

(5) Homogeneous grouping appears to be an advantage to accelerants but a disadvantage to non-accelerants. In five comparisons, one of which was significant, accelerants in homogeneously accelerated classes achieved higher than accelerants in mixed classes. In four comparisons, one of which was significant, non-accelerants in mixed classes achieved higher than non-accelerants in homogeneous classes.

(6) It is difficult to assess the achievement increment per grade of acceleration on the basis of these studies. Several sixth grade classes that began acceleration in grade four were able to complete the seventh grade textbook material. Grade equivalents

based on junior high school norms indicate that sixth grade pupils who started acceleration in grades four or five equal the scores made by students mid-way in the ninth grade. It seems quite reasonable to conclude that pupils qualifying for acceleration in grade three and probably those not qualifying until grade four, are able to complete five years of arithmetic achievement in the four year period from third to sixth grade.

## ARTICULATION BETWEEN THE ACCELERATED ARITHMETIC PROGRAM AND THE SEVENTH GRADE CONVENTIONAL AND SMSG MATHEMATICS CURRICULA

It is apparent that an accelerated program begun in the elementary school should be continued and reinforced in the junior high school to become fully effective. Sectioning pupils who were accelerated in elementary school into the same seventh grade classes is relatively easy to accomplish. Being assured that further instruction will begin where previous instruction ended is more difficult.

This problem is magnified in Cincinnati due to the use of the Special Mathematics Study Group (SMSG) mathematics curriculum in about 10 per cent of all seventh grade classes. The SMSG program represents a more conceptual and fundamental view of mathematics than does the conventional curriculum. Since the SMSG curriculum is assigned to schools and classes containing more able students, it follows that a high proportion of elementary school accelerants would be placed in SMSG classes in the seventh grade.

It is important, therefore, to know whether the conventional and SMSG curricula and instruction articulate well with the accelerated program in the elementary school. The study is based on the assumption that higher achievement reflects better articulation. The limitations of this study are similar to those explained in Part 1. The most significant limitation is that groups to be compared were selected "after the fact," that is, as they were found, rather than placed for the purposes of the experiment.

Perhaps the study may be oriented best by citing the following questions:

(1) Do accelerants achieve higher than non-accelerants in the conventional seventh grade mathematics curriculum?

(2) Do accelerants achieve higher than non-accelerants in the seventh grade SMSG curriculum?

(3) In regard to the achievement referred to in questions 1 and 2, is there a difference among groups between achievement unique to SMSG and achievement fostered by the conventional curriculum?

To answer these questions, four groups of seventh grade students were identified: accelerants in the SMSG program (A-SMSG); accelerants in the conventional program (A-C); non-accelerants in the SMSG program

(NA-SMSG); and non-accelerants in the conventional program (NA-C). A special test was constructed consisting of fifty items. Twenty-five of the items were considered unique to the SMSG curriculum, while the remaining twenty-five items were considered typical of the conventional curriculum. Both elementary and secondary supervisors agreed on the classification of test items. This instrument was administered in June, 1962, to a large number of seventh grade classes. After testing, the pupils were classified into one of the four categories previously mentioned. Within each group, except the accelerants in the conventional program, a random selection of 100 pupils was made. Since there were only thirty-seven accelerants in the conventional program, all were used in the analysis.

Differences in mental ability among the four groups were statistically controlled through a one-way classification analysis of covariance. Mental ability measurements were obtained from the *Lorge-Thorndike Intelligence Tests, Verbal Battery,* administered in grade six.

**Results**

The twenty-five test items measuring conventional achievement and the twenty-five measuring uniquely SMSG achievement were scored and analyzed separately. Since there were four choices for each item, a mean score of $\frac{25}{4}$ or 6.25 is to be expected by chance alone.

The adjusted group means of the conventional test show the following rank order from high to low: A-SMSG; A-C; NA-SMSG; and NA-C. One would expect students in the conventional program to do better on conventional items than students in the SMSG program. Apparently this is not true.

The adjusted group means of the SMSG test show the following rank order: A-SMSG; NA-SMSG; A-C; and NA-C. These results conform to expectation in the sense that both SMSG groups are higher than both the conventional groups. The adjusted means of 8.95 and 7.97 for the A-C and NA-C groups, respectively, are not too far above chance scores. Apparently, very little SMSG content is taught in the conventional program.

A test of the significance of the adjusted mean differences was made and the pertinent data is reported.

The first comparison involves accelerants versus non-accelerants, all of whom were in the SMSG program. On both the conventional and SMSG subtests, the accelerants achieved significantly higher. The second comparison involves accelerants versus non-accelerants, all of whom were in the conventional program. Accelerants achieved significantly higher scores on the conventional subtest and higher, but not significantly so, on the SMSG subtest.

Comparisons 3 and 4, while not of direct interest to this study, are interesting. Comparison 3 holds acceleration constant and compares the conventional and SMSG programs. It shows that the SMSG group achieves significantly higher not only on the SMSG subtest, but also on the conventional subtest. Comparison 4 holds non-accelerants constant and shows again that the SMSG group achieves higher on both subtests.

**Conclusions to Part 2**

(1) Students who were accelerated in the elementary school and who pursued the SMSG program in grade seven achieved significantly higher on both conventional and SMSG subject matter tests as compared to non-accelerated students in the SMSG program.

(2) Students who were accelerated and who pursued a conventional seventh grade program achieved significantly higher on a conventional subject matter test than did non-accelerants in the conventional program. There was no significant difference between these two groups on the SMSG subtest.

(3) The SMSG program produces significantly higher achievement than the conventional program in both conventional and SMSG subject matter, regardless of whether the students were or were not accelerated in the elementary school.

(4) The effects of acceleration and the SMSG program appear to be additive in terms of increased achievement in both conventional and SMSG subject matter.

## DISCUSSION

In the absence of an unbiased and self-contained design, knowledge and judgment must be relied upon to identify and assess the effects of biasing factors. In this report it has been attempted in various ways to define control groups which minimize or cancel the effects of factors which may cause bias. No single comparison, however, was completely free of all possible biasing factors. The fact remains that if bias were present, it probably favored the accelerated pupils. The consistent superiority of acceleration against various control conditions, together with subjective evaluation of biasing factors, leads to the conclusion that the accelerated program is effective in increasing pupil achievement with no apparent harmful or negative effects.

Throughout this report reference has been made to the accelerated arithmetic program rather than simply acceleration. This was done to emphasize the fact that the program consists of more than simple acceleration. In addition to pupil acceleration causing increased achievement, there are also the effects of the special supervision given this project and the various workshops for teachers in accelerated schools. Arithmetic teachers in the accelerated schools now are given more intensive and perhaps more specialized help in teaching arithmetic than they were given before the accelerated program began. This help, together with in-service teacher training and the halo surrounding an experiment, may at least partially account for the higher achievement of accelerated pupils. An evaluation of these factors must be made eventually to determine the nature of the program in the future.

# ADVANCED PLACEMENT IN OHIO

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Regardless of how it is defined, it may be asserted with reasonable confidence that acceleration in one form or another, and to one degree or another, has become an accepted part of many programs for the academically talented in the elementary and secondary schools.

The national Advanced Placement Program is an instrument used for both enrichment and acceleration in the secondary schools. While it involves the early completion of school subjects, the content of courses is not necessarily greater in bulk but greater in intensity. The program aims to give the student a study in depth in a prescribed number of subject areas, providing him with the tools, methods, experience, and excitement which will lead him, at a later time in college and after, to generalization and synthesis. With its present set of examinations, the Advanced Placement Program promotes the idea of advancement to higher level courses in college at the beginning of the college career.

Put another way, it can be said that the basic intent of the Advanced Placement Program is two-fold; first to provide the academically talented student with a deeper and broader educational experience in the high school than he might ordinarily obtain, thus preparing him more effectively for college work—and second, to enable him to earn college credit while he is still in high school and thus to accelerate his progress or enrich his progress toward his final educational objectives—whatever these may be.

The Advanced Placement Program is in its eighth year as a project of the College Entrance Examination Board and has the help of the Educational Testing Service. Thirteen AP examinations are offered—American History, Biology, Chemistry, English, European History, French, Intermediate German, Advanced German, Latin 4, Latin 5, Mathematics, Physics, and Spanish. Each examination is prepared by a committee of five teachers, three from colleges and two from secondary schools.

Students are allowed three hours to complete each examination. Essay questions predominate, but are supplemented in some of the examinations by objective questions. Each modern language examination includes a listening comprehension section that uses tape recordings to test the student's ability to understand the spoken language. The examinations are offered once each year in the month of May.

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The examinations are graded in June by a committee of readers composed of teachers from schools and colleges throughout the country. A five point scale is employed: 5—high honors, 4—honors, 3—good, 2—credit, 1—no credit.

Materials supporting a candidate's request for credit and placement are sent only to the college that he is entering. These materials, which are received in July by the college, include a school report which gives a description of the advanced course or courses taken, the course grades, and the school recommendation regarding college credit or placement. The college also receives an AP Examination Report which includes examination questions, the student's paper, the grade given him by the reading committee, and interpretive information on examination grades.

The Advanced Placement Program begins in a school when college-level courses are given to able and ambitious students. The program has no formal membership—there is nothing to join; no permission to obtain. The program itself stipulates no requirements as to selection of teachers or students—and prescribes nothing with respect to the organization, scheduling or conduct of the courses. Any high school that desires to give Advanced Placement work is free to do so at any time and in any fashion that it chooses. Assistance and advice are always available, but there are no prescriptive rules and regulations. In establishing courses, each school is guided by its own aspirations and resources, strengths and individual circumstances. Among its considerations will be: gaining community support, selecting the students, staffing the courses, and providing additional resources that might be needed.

In Ohio, there has been a substantial effort to extend the Advanced Placement Program through cooperative endeavors of colleges and school systems. The initiative came from the Inter-University Council, composed of the presidents of the six state-supported institutions of higher learning. With the support of a grant from the Fund for the Advancement of Education, the Ohio Council on Advanced Placement was formed in 1959. Made up of representatives from a number of private and public colleges and universities and public and independent secondary schools, the Council undertook a short-term program to stimulate participation by institutions of higher learning and high schools throughout the state.

The results of this cooperative effort can be seen in the following table.

## ADVANCED PLACEMENT PROGRAM IN OHIO, 1959-1962

| | *1959* | *1960* | *1961* | *1962* |
|---|---|---|---|---|
| Secondary Schools | 23 | 46 | 88 | 111 |
| Candidates | 331 | 662 | 1043 | 1104 |
| Examinations | 427 | 837 | 1217 | 1396 |
| English | 159 | 286 | 464 | 429 |
| Mathematics | 119 | 211 | 255 | 253 |
| American History | 37 | 70 | 156 | 243 |
| Chemistry | 64 | 90 | 89 | 143 |
| European History | 13 | 86 | 102 | 130 |
| Biology | 6 | 28 | 34 | 47 |
| Physics | 6 | 23 | 29 | 39 |
| Latin IV | 8 | 17 | 26 | 34 |
| French | 8 | 16 | 24 | 25 |
| Spanish | 3 | 5 | 21 | 23 |
| Intermediate German | 4 | 4 | 12 | 10 |
| Advanced German | 0 | 2 | 4 | 6 |
| Latin V | 0 | 0 | 1 | 0 |

Approximately twenty of the higher institutions in Ohio were on record in 1959 in connection with support of the Advanced Placement Program. By 1962, forty-six of the Ohio colleges and universities indicated willingness to grant placement or credit, or placement *and* credit to students who performed creditably in the appropriate examination.

In May of 1962, one hundred fifty college representatives assembled in Columbus to review the status of the program and to consider acceptance of a basic policy statement. The following was adopted without dissent:

A. The Advanced Placement Program is predicated on two assumptions, both of which we believe to be well founded:

1. (a) Many secondary schools are equipped with some faculty who are competent to offer selected courses at the college level in a variety of subject areas.

   (b) Some able students through independent study may arrive at a level of academic accomplishment equivalent to that achieved in college-level courses.

2. The Advanced Placement Examinations of the College Entrance Examination Board provide a valid evaluation of the academic competence of secondary school students in college-level subject areas.

B. We hold that institutions of higher learning should accept these assumptions. It follows that such institutions should award advanced placement and full credit for their appropriate courses on the basis of a satisfactory score on the appropriate Advanced Placement Examination.

C. When an institution awards advanced placement and credit to a student on the basis of an Advanced Placement examination score, it should expect that the performance of the student in subsequent related courses will be substantially the same as that of any other student who has satisfactorily completed the normal prerequisite course at the institution.

At this point, it should be explained that the Ohio Council on Advanced Placement was originally conceived as a one or two year venture. It was felt that this would provide sufficient time for stimulation of the program in the state. At the urging of both school and college people, however, important aspects of the program continue to be fostered by the Division of Special Education, Ohio Department of Education, and by a sub-committee of the Ohio College Association.

The experience of the Ohio Council on Advanced Placement supports these conclusions:

— The Advanced Placement Program is a worthy instrument of quality education, as long as its flexibility, its potential, and its limitations are clearly recognized.

— It is producing a qualitative improvement in educational opportunities and experiences for able and ambitious students.

— The internal problems it presents to schools and colleges are mainly the usual ones that accompany efforts to provide high quality education.

— It is important to be vigilant in holding Advanced Placement to its original objectives and educational purposes; and not permit it in any way to deteriorate into an examination game.

— A strong, integrated Advanced Placement Program cannot help but bring colleges and schools closer together.

A school's decision on how many Advanced Placement courses a student should take is often based on what attitude the school takes on the question of acceleration versus enrichment. Those who believe that acceleration in time is desirable for the able student must necessarily allow that student to proceed apace in several subject areas, if they are to maintain consistency in their philosophy. On the other hand, those who believe that enrichment is preferable, without a decrease in the amount of time spent in school, find no difficulty at all in holding students to participation in one or two Advanced Placement courses and examinations at the most.

However, neither of these approaches need necessarily exclude acceleration or enrichment. It is, for instance, perfectly possible to allow a student to take as many Advanced Placement courses as he wants without decreasing the amount of time spent in school. Moreover, it is possible to move a student ahead faster in one or two subjects without accelerating the student across the board.

Quality of performance, not quantity of output, is what is important. A greater amount of effort on the part of the student is probably required in an Advanced Placement course since he is dealing with subject matter in greater depth. But it is also true that he can handle high quality work in about the same amount of time that he would spend on regular secondary school work if he utilizes his time efficiently.

Among the many schemes devised for enriching and accelerating the education of academically talented students, the Advanced Placement Program stands out as not only sound and sensible but also as having very wide applicability. For the student, it offers both immediate, practical rewards and long-range educational advantages.

# AN ADVANCED PLACEMENT PROGRAM IN ENGLISH

MILDRED ABBOTT AND VERDA EVANS
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Recognition by the Cleveland Public Schools of the necessity for providing courses that would enable superior English students to enter the College Entrance Examination Board's Advanced Placement Program led to the establishment of college level classes in English in September, 1960.

The Advanced Placement Program is a logical extension of the Major Work Program initiated forty years ago in Cleveland. The Major Work Program is the oldest organized plan in the nation for providing special enrichment classes for gifted children in the elementary school. Some years ago Major Work Centers were added to the junior high school program, and the current development of Honors English courses to prepare students for Advanced Placement in their senior year moves this program into the senior high school. The senior high school English Honors Program follows the enrichment pattern set in the elementary school by accelerating subject matter rather than students.

Two unique and immeasurably valuable features of the Cleveland Advanced Placement Program have been implemented by grants from the Department of Education of the State of Ohio. These grants have made possible a series of workshops for teachers of Advanced Placement English, and a series of enrichment meetings for Advanced Placement students. Both features have been in operation since the inception of Advanced Placement English.

Each semester three Saturday morning workshops, which Advanced Placement teachers are paid to attend, are held under the leadership of the Supervisor of English. Over the past two years the teachers have discussed individual works of literature and their place in the course, teaching techniques for specific units, setting and evaluating examination questions and making composition assignments. In addition, these teachers constitute an advisory committee for teachers who are developing the three-year Honors Program in the English Experimental Center at John Adams High School.

Every one of the teachers has expressed his appreciation and need for the opportunity to exchange ideas and to share in curriculum planning at the teacher workshops. In a report to the State Department of Education in 1961, the following evaluation of the workshops was made:

> The value of the workshops cannot be questioned. Whatever improvement we were able to make in the course of study . . . grew out of these Saturday morning meetings . . . Moreover, the workshops provide constant evaluation during the year.
>
> We consider the teacher workshops the most valuable single item in the Cleveland Advanced Placement Program in English. Two-way communication and sharing of ideas and problems are basic in working out a successful city-wide program involving a number of high schools.

Besides attending the regular workshops, the Advanced Placement teachers keep in touch with other programs and other teachers of gifted students by attending area Advanced Placement meetings, as well as professional meetings of the state and local English associations. One of the teachers has been an Advanced Placement examination reader for the CEEB (College Entrance Examination Board).

The student enrichment series held at School Headquarters, originally on Saturday but changed to Monday evenings after the first year, has varied in number from twelve to six a semester. Students from each of the schools offering Advanced Placement English classes attend. This fall, the average attendance has been 85.

Under the supervision of a paid teacher, the students meet to hear lectures by local college professors, to experience the kind of testing situation required by the CEEB Advanced Placement Program, to share ideas with their peers from other schools, and to meet and talk with teachers from participating schools.

Lecture titles are announced in advance of the evening meetings, so that teachers may assign—for class study or for independent reading—those works which the lecturers will discuss.

A typical semester's enrichment series includes a lecture on Joyce's *A Portrait of the Artist as a Young Man,* a comparison of two literary works, a discussion of a Shakespearean play, a talk by a local author, a two-hour examination requiring analysis of a poem and the writing of an essay answering a general question on literature, and a roundup of the semester's work at which the Advanced Placement teachers give the students practical approaches in answering general literature questions.

These roundup sessions followed a study of answers to essay questions in the teacher workshops. The study revealed that students needed direction and practice in answering general questions on literature. It showed that teachers needed direction in setting the right kind of essay questions. Teachers making the study agreed that there is no magic in the essay examination. The magic is in asking the right kind of essay question. These findings led to suggestions that the teachers of the academically talented make carefully structured daily assignments and develop examination questions that would help students to develop skill in analyzing questions, to present a point of view, to choose suitable illustrations, and to show relationships.

Examinations written at the evening student meetings are graded by two Advanced Placement teachers other than the student's own teacher. Grades are based on standards similar to those used by the CEEB readers. If the teachers' grades differ too widely, a third person reads the paper. Graded as anonymously and as objectively as possible, the papers are then returned to the individual schools where they are discussed in class.

Cleveland's experience in conducting Advanced Placement English has made it clear that the careful selection of students is of primary importance. Principals, English teachers, and guidance counselors use all available criteria—intelligence quotients, English marks, reading and other test scores, and teacher recommendations—in selecting students. In addition, the student's interest in English is of prime importance, since English Advanced Placement competes with several other Advanced Placement courses. Students are advised to enroll in only one or not more than two Advanced Placement courses.

Students enrolled in Advanced Placement English this fall average 125 PLR (group intelligence score). They have records of A's in English and all of their verbal scores are high. Their extracurricular activities range widely. They include music, journalism, dramatics, football, wrestling.

Despite continuously more stringent selection standards, due in part to the establishment of Honors English in the tenth grade, the number of students enrolled in Advanced Placement English has increased over the year. In the fall semester of 1961, 56 students were enrolled city-wide; in the fall of 1962, there were 88.

Only those students who do well in their senior year are encouraged to take the Advanced Placement examinations. In 1962, two-thirds of the students enrolled took the examination, and 81% received passing grades. The 1962 scores for Cleveland's students were 10% higher than those in 1961.

Teacher selection and teacher load are also important. No matter how well fitted to teach Advanced Placement English, the teacher must have sufficient preparation time. Teachers' schedules are carefully controlled in most buildings. An Advanced Placement course is considered equal to two average classes, which relieves the Advanced Placement teacher of part of his normal teaching load to enable him to make the extra preparation required by the advanced course. For the new teacher of Advanced Placement English, preparation is particularly heavy. Many of the works included in the curriculum are works he has not taught, and perhaps not read, since his own college days.

From the beginning, the planners of the Advanced Placement English curriculum in Cleveland have taken direction from suggestions made by the Committee on Advanced Placement of the CEEB, based upon their knowledge of the diversity of freshman English courses. The Committee in the *1961 Acorn Book* suggests that —

> "an Advanced Placement course should not attempt a survey of English or American literature, although most selections should be those which are recognized as having made significant contributions to our literary heritage. The course should rather emphasize a close study of relatively few works."

The student's work in composition —

> "should be primarily critical and expository; he will be expected to think clearly, to write correctly, and to produce orderly, unified essays."

Although some specific works of literature are now suggested in the CEEB course descriptions, the Committee continues to emphasize that "no question on the examination . . . will name a specific work and require the candidate to discuss it."

Administrative procedure for the Cleveland Advanced Placement Program in English has changed considerably since its inception, occasioned chiefly by the difficulty of providing a framework of prerequisites and standards flexible enough to fit the needs of a dozen high schools within one school system. The curriculum itself has not changed. In each semester a number of units on types of literature are required. A few specific titles are required for all Advanced Placement students and others are offered as suggestions for the teachers. They select those which are best suited to the needs of their class. Each week, teachers are expected to assign at least one short (500-word) essay to be written, for the most part, in the classroom.

Although the purposes of the Advanced Placement course in English and the basic textbooks are quite rigidly prescribed, teachers have always been free to experiment and to add materials of their own choice. No prescription has ever been made for methods of teaching except for open discussion directed toward getting students to think and to analyze in depth the material that they have been reading. Small classes, and the assurance of small classes continuing in the future, have been of considerable help to teacher morale and achievement.

Required texts are *Sound and Sense, An Introduction to Poetry,* by Laurence Perrine (Harcourt, Brace, and World); *Writing Prose: Techniques and Purposes,* by Kane and Peters (Oxford University Press); and *Studies in the Short Story,* by Jaffe and Scott (Holt, Rinehart, and Winston).

Teachers are permitted to make their selections from the three required texts. Currently there are only two other items on the required list: Joyce's *A Portrait of the Artist,* and *Oedipus Rex.* Both selections have been popular with both teachers and students. The play is supplemented by use of the Encyclopedia Britannica *Humanities* film series narrated by Professor Bernard Knox.

Students usually make a study of tragic drama, using the paperback *Eight Great Tragedies,* which includes essays by Aristotle, Hume, Emerson, Tillyard, Richards, and Krutch. Other plays include titles from Ibsen and Shaw. Students probably read more novels over the year than any other one type of literature.

Probably the most important recommendation of the Advanced Placement English teachers at the end of their first year of teaching the college-level literature and composition course was that students should be very carefully selected for such a course. Among the suggestions for improving the program was the establishment of a Three-Year Honors English Program that would permit early selection of gifted students.

In June, 1961 an administrative order established such a program and provided a transitional plan to be used until the schools could establish the complete Honors Program. The transitional plan was also to be used in those schools whose smaller enrollments precluded their taking part in the Three-Year plan.

The transitional program involves continuance of the current practice of scheduling both twelfth-year English and Advanced Placement English in the senior year. For those schools that will establish the Honors Program in September, 1962, at the 10B level, the transitional program will remain in effect until 1964, when students who began Honors English in 10B start their senior year. Although the plan was established in the summer of 1961, only two schools were able to begin Honors work in September, 1961. In some schools it may be necessary to continue the transitional program for the few students who will enter high school in January and carry the Three-Year Program for those who enter in September. The deciding factor will always be the number of students whose school records and teacher recommendations suggest that they should be given Honors work in English.

Honors English is a program of curriculum acceleration designed for gifted students leading to senior year Advanced Placement or college-level English. Essentially, the tenth grade Honors course combines the major units from the tenth and eleventh years of regular English, and the eleventh grade Honors course covers the present twelfth grade work in regular English. An independent summer reading list covering specified titles further implements the Honors courses.

This requirement is made a part of the program by a two-week seminar on summer reading that introduces each of the 10B, 11B, and 12B semesters. All of the books are integrated with the Three-Year Program.

The Honors and Advanced Placement English Course of Study prescribes a rich list of literary works on which to center literature instruction within a sequential and cumulative framework.

The 10B semester is used to introduce the student to the variety and types of literature to be encountered in future semesters. Every literary selection and composition topic is relevant to subsequent choices of literary work and subsequent topics for discussion and writing. The student is gradually prepared for analytic-comparative writing, beginning with the seminar on Summer Reading List I. References are also made to junior high reading.

The 10A semester traces significant developments in American literature, thoroughly acquainting the student with some important works written prior to the 20th century. In general, fragments of literary works are avoided. Again, each selection has been made with relevance to future high school and college reading.

The program emphasis for the 11B semester is British literature through the 19th century. The 11A semester introduces the student to selected modern American and British literature and provides particularly heavy emphasis on composition. The twelfth year course, Advanced Placement, continues the emphasis on composition, with particular concern for close analysis of significant poetry, short stories, plays, and novels. In essence, the twelfth year course is very little changed from the curriculum originally established for the Advanced Placement college-level course.

The entire Three-Year course is intended to be cumulative in its reference to earlier reading and composition work, and in its constant demands on the teacher and student to compare what they are reading with what they have read before. In the early semesters similarities in themes are emphasized; later, dissimilarities in the treatment of similar themes are suggested. The cumulative aspect of study is indexed at the end of each semester's guide for teachers.

One of the important dividends of this program for the entire system is that the Advanced Placement teachers have created a more stimulating climate in all of their classes as a result of the additional reading and new approaches demanded in their advanced groups.

Alva R. Dittrick, Deputy Superintendent, in the foreword to the 1961 report to the Ohio Department of Education said, "The contagion of achievement is the bright promise of the Advanced Placement Program in the Cleveland Public Schools." This promise is slowly becoming reality.

# AN ACCELERATED MATHEMATICS PROGRAM

LAWRENCE HYMAN, MARTIN PREUSS AND JAMES CLEMENT
*Cleveland City Schools*

Many educators, particularly those interested in the teaching of mathematics, are of the opinion that academically talented pupils can move more rapidly through the traditional mathematics than they do at present.

At the 42nd Annual Convention of Secondary School Principals at Indianapolis, Indiana in 1958, it was recommended that ". . . more capable students can complete the existing program for Grades 7 and 8 in one year. In Grade 9 they can begin the mathematics normally taken in Grade 10." In his second report to interested citizens, *Education in the Junior High School Years,*[1] Dr. James B. Conant made the following recommendation: "A small fraction of pupils should start algebra (or one of the new brands of mathematics) in Grade 8. The reason for the early identification of very able pupils and the start of mathematics beyond arithmetic in Grade 8 is that at least some of these pupils can complete a four-year sequence by the end of Grade 11 and be ready for college-freshman mathematics in Grade 12. This pattern reflects the Advanced Placement Program referred to in *The American High School Today.*"[2]

Aware of this viewpoint, two Cleveland Public School committees—the Principals' Curriculum Committee and the Curriculum Coordinating Committee for the Academically Talented—focused their attention on the problem. Members of the committees studied the literature pertaining to the question, visited other school systems that were considering the same problem, and utilized the experiences of the Cleveland Major Work Program for the Gifted.

One result of the study was the recommendation that rather than wait until a complete revision of the mathematics curriculum K-12 could be effected, an experimental accelerated mathematics program should be initiated in several selected secondary schools at two levels, the junior high and the senior high.

It can readily be seen that the proposed program would be one of long range. It would necessitate projecting plans several years into the future in order to make adequate provision for advanced terminal courses and to give teacher personnel an opportunity to be trained and ready to teach the advanced mathematics that would be introduced in the junior and senior years of high school. In view of this fact, the committees further recommended that the major emphasis should be at the junior high level, with a constant view toward integration with the senior high curriculum.

The 1960-61 school year marked the beginning of this experimental program in the Cleveland Public Schools. The Cleveland Board of Education has been aided in this project by a grant awarded by the Division of Special Education, Ohio Department of Education.

**Purpose**

The objectives of the experimental accelerated mathematics program for secondary schools are as follows:

(1) To determine the advisability of having academically talented students:
   (a) complete the seventh and eighth grade course of study in the seventh grade
   (b) study elementary algebra in the eighth grade
   (c) study a combined course in plane and solid geometry in the ninth grade

(2) To determine what mathematics courses shall be taught in the year and one-half made possible under the plan outlined above.

This acceleration of subject matter would give academically talented pupils an opportunity to take an additional three semesters of college preparatory mathematics before graduation from high school. It would also make it possible for pupils whose educational and career plans do not require additional mathematics to schedule other subjects to provide a more thorough preparation in their area of major interest.

## PROPOSED SEQUENCE OF ACCELERATED MATHEMATICS COURSES FOR ACADEMICALLY TALENTED PUPILS

The following sequence of courses was proposed to avoid the necessity of awaiting a complete revision of the mathematics curriculum—kindergarten through twelfth grade.

| *Accelerated Track I* | (Where Algebra I and II are studied in the eighth grade) |
|---|---|
| 7B | 7B and 7A Arithmetic |
| 7A | 8B and 8A Arithmetic |
| 8B | Algebra I |
| 8A | Algebra II |
| 9B | Plane and Solid Geometry |
| 9A | Plane and Solid Geometry |
| 10B | Intermediate Algebra (Algebra III) |
| 10A | Trigonometry (or Algebra IV) |
| 11B | Algebra IV (or Trigonometry) |
| 11A | Advanced Mathematics I<br>Integrating Algebra, Geometry, Trigonometry |
| 12B | Analytic Geometry and Calculus |
| 12A | Analytic Geometry and Calculus |

*Accelerated Track II* (Where Algebra I and II are studied in the ninth grade)

| | |
|---|---|
| 10B | Plane and Solid Geometry |
| 10A | Plane and Solid Geometry |
| 11B | Intermediate Algebra (Algebra III) |
| 11A | Trigonometry (or Algebra IV) |
| 12B | Algebra IV (or Trigonometry) |
| 12A | Advanced Mathematics I<br>Integrating Algebra, Geometry, Trigonometry |

This sequence was begun experimentally at the seventh and tenth grade levels. The two track approach provides some additional flexibility for pupil personnel, as well as avoiding the revision problems caused by starting at the twelfth grade and proceeding in reverse. Qualified secondary school pupils may gain access to the accelerated mathematics program at any level by taking the appropriate prerequisite courses.

## THE JUNIOR HIGH PROGRAM

The experiment accelerating the seventh grade mathematics program for academically talented pupils was begun in the Fall semester of the 1960-61 school year. The purpose of this phase of the experiment was to combine the topics of seventh and eighth grade mathematics into a one-year course.

### Selection of Schools

The schools selected for the experiment were the three junior high Major Work Centers and four representative junior high schools. The schools selected were located in different geographical areas of the city in order to have a cross section of the school population in the program.

Nine classes were organized to start on September 6, 1960. At the opening of the Spring semester in January, 1961, four more beginning classes were formed. Thirteen classes, therefore, were involved in the experimental program during the first year.

The same seven schools continued in the program the second year. In the Fall term, twenty-two classes were organized. These classes consisted of nine classes in 8B Algebra I, four classes in second semester seventh grade arithmetic and nine classes in first semester seventh grade arithmetic.

Five more first semester seventh grade classes were added in February, 1962. Thus, a total of twenty-seven classes were involved during the second year of the experimental program.

### Identification Criteria for Junior High

These criteria were suggested for use in selecting pupils for the program:

(1) For pupils in the Major Work Centers, an I. Q. score of at least 125.
(2) For pupils in the representative schools, a PLR (group intelligence test score) of at least 115.
(3) A score at the end of the sixth grade of at least 7.7 on the *Stanford Intermediate Arithmetic Achievement Test.*
(4) Superior achievement as evidenced by school marks.
(5) Recommendation of teacher, principal, and school counselor. (Note: To avoid losing the "late bloomer," a pupil who has demonstrated high potential but who may not qualify in some of the above criteria may be included in this program.)
(6) After the experience of the first year, it was suggested that in the future the criteria include a sixth grade score of at least 7.7 on the *Stanford Intermediate Reading Test.*

**Coordinator**

To crystallize objectives and to facilitate progress in the experimental program, a coordinating teacher was appointed on a full-time basis with an office located in the Cleveland Board of Education Administration Building. His duties included the following:

(1) Counsel mathematics teachers who are teaching the academically talented pupils in the selected schools.
(2) Consult with principals and mathematics department chairman in the experimental schools.
(3) Plan and conduct workshops.
(4) Serve as chairman of a steering committee.
(5) Evaluate the experimental mathematics program in the secondary schools.
(6) Study mathematics journals, professional publications, books, etc., for the purpose of discovering what is being done in this area of mathematics education.
(7) Develop plans for the additional year and one-half of mathematics that is to be taught to the academically talented pupils in the senior high.

**Steering Committee**

Since the main focus of interest was in the development of a continuous program beginning with grade seven, it was decided that a committee of junior high personnel would best fulfill that purpose. A steering committee composed of one mathematics teacher from each of the participating junior high schools was organized under the chairmanship of the coordinating teacher.

The responsibilities of the committee were:

(1) To establish criteria for the selection of pupils who were to be given the opportunity to enroll in the mathematics classes for the academically talented.

(2) To decide what should be retained and what should be omitted in the seventh grade in order to make it possible for the academically talented pupils to complete the seventh and eighth grade course of study in one year without sacrificing competence in mathematics.

(3) To meet monthly to discuss the progress of the program.

(4) To study and evaluate test results.

The committee met as scheduled and formulated the criteria mentioned previously. Members demonstrated devices and methods of presentation which had proved to be successful. The coordinator introduced materials and literature pertinent to the program. One valuable by-product of these meetings was the *esprit-de-corps* which resulted from the exchange of ideas, discussion of mutual problems, and the determination of procedures to be used in the accelerated classes.

### Junior High Curriculum Committee

A mathematics curriculum committee composed of three members of the steering committee and the coordinator was employed during the summer of 1961 and 1962 to evaluate and summarize the first and second years of the program. The responsibilities of the committee included the following duties:

(1) Prepare teachers' guides for the seventh accelerated mathematics course and the eighth grade algebra course.

(2) Recommend methods and techniques for the instruction of the academically talented in mathematics.

(3) Recommend filmstrips, slides and other visual aids for improvement of mathematics instruction for the academically talented.

(4) Develop aids and devices to improve instruction in mathematics for academically talented students.

(5) Recommend classroom equipment.

(6) Prepare a bibliography of books, pamphlets, and periodicals for teachers of the academically talented.

### Workshops

Three all-day workshops were conducted in the first two years of the junior high program. An average of thirty teachers attended each workshop. In addition to those actively engaged in the program, other teachers were invited in order to alert them to the scope and possibilities of acceleration in mathematics. Nationally known educators prominent in the field of mathematics served as consultants.

The first workshop in October, 1960 was primarily of an exploratory nature. Dr. Phillip S. Jones, President of the National Council of Teachers of Mathematics, discussed trends in mathematics. The need for change in the mathematics curriculum with greater stress on concept and structure was emphasized.

April, 1961 was the date of the next workshop. Methods of teaching the academically talented were illustrated by Miss Mildred Keiffer, Supervisor of Mathematics in the Cincinnati Public School System. Special emphasis was placed on the discovery and developmental approach in mathematics.

The third workshop took place in October, 1961. Again methods of teaching the academically talented were illustrated. The consultant, Miss Veryl Schult, Supervising Director of Mathematics in the Washington, D. C. Public Schools, brought out several important points:

(1) The teaching of academically talented pupils in special classes does not negate the idea of equality of education.

(2) In dealing with the academically talented, there are four general groups of concern:

  (a) those with high intelligence and deep interest in mathematics

  (b) those with high ability who are not working up to their capacity

  (c) those from low socio-economic areas who have not had the opportunity to develop their innate ability

  (d) those of high ability and mediocre achievement

(3) Teachers must cultivate and use a more precise vocabulary in the teaching of mathematics.

The success of the workshops prompted the Division of Mathematics to conduct other in-service training workshops for teachers of junior high school mathematics. Here, the main purpose was to inspire a more meaningful teaching of mathematics leading to a better understanding of the basic structure of the subject, thus providing a firmer foundation for later courses. The expositions and demonstrations of methods and materials were designed to provide deeper insight for the participants, to give ideas for individual research projects for pupils, and to encourage teachers to teach more for understanding than for manipulation.

## THE SENIOR HIGH PROGRAM

During the 1960-61 school year, five senior high schools participated in an experimental program of combined plane and solid geometry for academically talented pupils in the tenth grade. In the first semester, nine classes were organized with three more being added at the beginning of the second semester, bringing the total to twelve classes.

In the second year of the program, all senior high schools were authorized to offer the combined plane and solid geometry course to their academically talented pupils. The fall term opened with a total of twenty-four classes, of which eighteen were in Plane and Solid Geometry I. Although seven additional classes in the geometry course were formed in the Spring semester, there remained a total of twenty-nine classes due to attrition of pupil personnel.

## SEQUENCE OF COURSES FOR SENIOR HIGH ACADEMICALLY TALENTED PUPILS

| | |
|---|---|
| 10B | Plane and Solid Geometry I |
| 10A | Plane and Solid Geometry II |
| 11B | Algebra III (Intermediate) |
| 11A | Trigonometry |
| 12B | Algebra IV (College) |
| 12A | Advanced Mathematics I |

Note that the terminal course for those pupils who start the program at the tenth grade level is Advanced Mathematics I.

## EVALUATION

One method of evaluating an experimental program is to compare test results. A planned program of standardized tests in mathematics under the direction of the Bureau of Educational Research of the Cleveland Public Schools has been in effect for a number of years. The appropriate tests were administered to the experimental classes at the same time that they were given to the classes enrolled in the regular mathematics curriculum.

In the first year of the experiment, a comparison was made between the pupils in the accelerated classes and all of the pupils taking the same test. During the second year, a comparison with the best class within the same school was also made. In studying the test results, it should be kept in mind that in most cases the pupils in the experimental program were at least six months to one year younger chronologically than those in the regular curriculum.

### List of Tests

The following city-wide tests were administered:

Cleveland Public Schools Mathematics Achievement Test, Seventh Grade Final, Form A (Non-Standardized)
Iowa Algebra Aptitude Test
Stanford Advanced Arithmetic Test (Standardized)
Iowa Geometry Aptitude Test
Unit I Algebra Test (Non-Standardized)
Lankton First-Year Algebra Test (Standardized)
Shaycoft Plane Geometry Test (Standardized)
Cooperative Solid Geometry Test (Standardized)
Cooperative Intermediate Algebra Test (Standardized)
Cooperative Trigonometry Test (Standardized)

### Test Results

This section on evaluation compares the median scores of the classes in the accelerated program with the median scores of classes in the regular curriculum. Where possible, the median scores of the best classes in the regular curriculum are also compared.

Statistics were compiled by the Bureau of Educational Research of the Cleveland Public Schools.

No standardized test in mathematics being readily available for use at the end of the seventh grade, a non-standardized test prepared by the Division of Mathematics was used. The results indicate that pupils in the accelerated program scored better than the best comparable pupils within the same schools.

On the *Iowa Algebra Aptitude Test* in the Cleveland Public Schools, a score of 57 or above indicates that the pupil has superior aptitude for algebra. The results show that 66% of the academically talented 7A pupils achieved this score. By comparison, only 29% of the regular 8A pupils scored at 57 or above. Although the academically talented pupils had studied formal mathematics one year less than 8A pupils, their readiness for algebra is apparent.

The *Stanford Advanced Arithmetic Achievement Test* was given to the 7A and 8A students in June, 1961, January, 1962, and June, 1962. This test is divided into two sections, arithmetic reasoning and arithmetic comprehension. No appreciable difference in scores was noted between the 7A academically talented students and the best 8A pupils.

In February, 1962, the *Iowa Geometry Aptitude Test* was given to the academically talented 8A pupils and the 9A algebra pupils. In the Cleveland Schools, a score of 152 is used as a minimum criteria for success in geometry. It is interesting to note that no 8A pupil scored below the minimum index, and the percentage of those whose score indicates superior aptitude for geometry was almost identical to the best 9A algebra students.

The Algebra Test Unit I of the Cleveland Public Schools was given in the fifth week of the first semester of algebra to determine success in that course. The 8B accelerated mathematics pupils did as well as the best 9B pupils with whom they were compared.

The *Lankton First-Year Algebra Test* was administered to pupils at the end of one year's work in first year algebra. The Standard Scores on this test are such as to permit ready comparison of achievement with mental ability level. In spite of the fact that the best 9A pupils scored slightly better, a comparison of the group intelligence test score with the Standard Score shows that the accelerated pupils had a greater excess of Standard Score over the group intelligence test score.

At the end of the second semester, the *Shaycoft Plane Geometry Test* was administered to the academically talented pupils in combined plane and solid geometry and the regular pupils in plane geometry. In all cases the scores of the academically talented group exceeded the scores of the regular classes as well as the best classes within the same schools. The higher group intelligence test median is probably an important factor.

The *Coöperative Solid Geometry Test* is administered to the academically talented pupils at the end of two semesters of combined plane and solid geometry. The regular pupils take the test after two semesters of plane geometry and one semester of solid geometry. The results indicate that there is a slight loss at the solid geometry level. It is necessary to weigh this small loss against the gain of a full semester for the study of an advanced mathematics course.

On the *Cooperative Intermediate Algebra Test,* the median scores indicate that the pupils in the academically talented program do better than those in the regular curriculum. A definite superiority in performance of the academically talented pupils over those in the regular curriculum is indicated by the median scores on the *Cooperative Trigonometry Test.* The higher median on each of these tests is probably affected by the higher median group intelligence test score.

## COST FACTOR

The excess cost factor is one of several aspects that should be considered in an accelerated program for academically talented pupils. A number of elements enter into this cost. Among these are class size, additional supervision, supplementary materials in excess of the normal, and special equipment.

The costs for the 1961-62 school year were examined. It was found that the per-pupil teacher salary costs due to smaller class size were 16% more at the junior high level and 27% greater in the senior high. On projection into the twelfth grade it may be expected that because of pupil personnel loss resulting from diversification of interests and normal attrition, the excess per-pupil teacher salary cost due to smaller class size may well exceed 50%.

Using the average per-pupil cost of the Cleveland Public Schools and adding to this those costs attributed to the several factors mentioned in the first paragraph above, it was calculated that the cost of an accelerated program in mathematics was 4.4% greater in the junior high and 5.7% more in the senior high.

## RECOMMENDATIONS

On the basis of two years' experimentation, the Mathematics Curriculum Committee for Academically Talented Pupils suggests the following tentative recommendations:

(1) To realize the maximum results in such an accelerated program, class size should be held to the optimum appropriate for a specific school.

(2) A program of in-service training should be instituted for teachers of the academically talented.

(3) Consideration in respect to teacher load should be given to those teachers who are teaching classes in this accelerated program.

(4) Appropriate tests in the new mathematical concepts should be developed to measure pupil progress.

(5) A flexible classroom equipped with the best in teaching devices should be provided.

(6) Materials for experiments and pupil projects should be readily available within the classroom.

(7) Under-achievers should be re-scheduled into the regular mathematics program.

## CONCLUSIONS

Statistical evidence seems to indicate that the academically talented pupils in the accelerated program performed as well (except in solid geometry) as any pupils with whom they were compared. Readiness for more sophisticated courses in mathematics at an earlier chronological age is also generally apparent. We may infer that a program of accelerated mathematics is feasible for academically talented pupils with no loss in proficiency.

The success of an accelerated program in mathematics for the academically talented is predicated on several salient points:

(1) The cooperation of administrators, supervisors, teachers, parents, and pupils is necessary to initiate, conduct, implement, and coordinate a program of accelerated mathematics for the academically talented with a minimum degree of difficulty.

(2) Academically talented pupils must be identified and channeled into the program.

(3) An alert and adequately prepared faculty must accept the program with enthusiasm.

(4) The services of a coordinator are required to exercise general supervision of the program.

(5) Long-range planning is indispensible in the selection of terminal courses necessitated by the accelerated program.

(6) Additional funds will need to be allocated to provide for any excess costs incidental to the program.

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# ADVANCED PLACEMENT WORK IN CHEMISTRY UTILIZING TV LECTURES

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A cooperative Advanced Placement program in chemistry was conducted by Bowling Green State University in cooperation with 17 northwest Ohio high schools during the 1961-1962 school year. The high school students participating in the program did the work of a rigorous university beginning chemistry course, and took the College Entrance Examination Board's Advanced Placement Chemistry Examination near the end of the year.

The primary objective of the program was to explore the means by which students in high schools without regular Advanced Placement classes could undertake advanced placement work in chemistry. Additional aims were a comparison of the performance of high school students with that of university students in the same chemistry course, and an attempt to stimulate moderately capable high school students through their participation in the program.

The use of televised chemistry lectures presented on the Midwest Program on Airborne Television Instruction was an important feature of the program. Other students attended lectures on campus, except for two who studied independently. All but one of the participants came to the campus on Saturday for laboratory work and a recitation-discussion period.

The program also included a high school teacher participation option which provided for as many as three high school teachers to share in the instruction. This feature of the program operated only for part of one semester with one teacher involved.

## BACKGROUND

For many years numerous colleges and universities have individually provided examinations through which entering students could obtain advanced standing in various subjects. The enormous growth in the use of advanced standing in recent years has been mainly due to the activities of the College Entrance Examination Board, which in 1955 assumed responsibility for the continuation of an earlier experimental project of the Fund for the Advancement of Education. The brief bibliography appended to this report lists some of the publications of the Board relevant to its Advanced Placement Program. The most comprehensive of these is *Advanced Placement: Course Descriptions,* which suggests the level of presentation necessary in Advanced Placement courses in subjects for which the Board provides examinations. Sample examination questions for each field are also included. The College Entrance Examination Board also sponsors an annual conference in each subject matter field.

In the Chemistry section of *Advanced Placement: Course Descriptions,* it is estimated that a typical student in a college chemistry course will spend three 50-minute periods a week in class, between three and four hours a week in the laboratory, and about six hours a week in study. It is pointed out that it is necessary for high schools to plan on students spending an equivalent amount of time if they expect to qualify for Advanced Placement. It is stated in particular that the student in an Advanced Placement Chemistry course should spend at least 70 hours in individually performed laboratory work including some semi-quantitative experiments. A rather detailed discussion of the laboratory work expected is included because "the differences between college and secondary school chemistry are especially evident in the individual laboratory work" and because "colleges have reported that some candidates, while doing well on the examination, have been at a disadvantage because of too little laboratory experience."

The U. S. Department of Health, Education, and Welfare has published a booklet, *Advanced Standing,* as Number 8 of its New Dimensions in Higher Education series. This briefly describes the College Board Advanced Placement Program and also some other advanced standing programs. Most of those mentioned involve high school students either auditing or taking for credit regular courses at a neighboring college or university. The Ohio colleges and universities cited are The Ohio State University, which is indicated as having admitted high school students to mathematics and other unspecified courses, and the University of Akron (courses unspecified).

It was noted above that laboratory work presents a special problem for the student who wants to obtain advanced placement in chemistry. A similar situation exists for biology and physics, the other sciences in which College Board Advanced Placement Examinations are offered. It appears essential for a student to have had laboratory work equivalent to that of a college course if he is to achieve advanced placement at most colleges, and if he is to be prepared to proceed with the next course in sequence without being at a disadvantage. It has been indicated repeatedly at Advanced Placement Chemistry Conferences that many high schools find it extremely difficult to schedule for either students or teachers the necessary number of hours, particularly the blocks of time required for satisfactory laboratory work. It would seem to be similarly difficult in most cases to arrange a student's schedule so that he can take chemistry, biology, or physics at a neighboring college.

## Relevant Experience in Northwest Ohio

The idea of a cooperative Advanced Placement program in chemistry was based on two premises: first, that there were numerous students in the area capable of advanced placement work in chemistry, and second, that the high schools involved were interested, but unlikely to be able to provide such work individually in the near future.

Approximately 300 high school students were given chemistry tests by the Chemistry Department of Bowling Green State University in the period of 1958-1961 inclusive. This was done in the course of selecting participants for two types of high school chemistry programs conducted by the department. In 1958 and 1959, Dr. Joseph E. Weber, after several years of single-session lecture-demonstrations in organic chemistry, organized a program in which 16-20 students came to the university campus one afternoon a week for six weeks for a brief lecture and individual laboratory work in organic chemistry. In 1960 and 1961 the department conducted Summer Programs for High School Students under grants from the National Science Foundation.

All of these programs were well received by the parents and schools of the students involved. The performance of the participants in the programs, and a comparison of the scores made by high school students on the selection tests with those of Bowling Green State University chemistry students indicated clearly that numerous high school students would have been well qualified to take a rigorous college chemistry course. In most cases, individual high schools appeared to have from one to three qualified students.

The concept of Advanced Placement courses in chemistry has been well publicized in northwest Ohio. It was a principle topic in 1960 and 1961 at meetings for high school teachers and administrators organized by the Ohio Council on Advanced Placement, the Ohio High School Principals Association, the Ohio College Association, and the Northwest Ohio Chemistry Teachers Association. Although attendance at these meetings was good and most of those present were sympathetic to the idea of Advanced Placement, there were few indications that schools planned to initiate Advanced Placement classes in chemistry. Major deterrents seemed to be that most of the schools felt that they would have too few students for such a course to warrant the instructional time required, and that it would be difficult to schedule the necessary laboratory time.

Since many factors are involved, there is obviously no minimum high school enrollment required to sustain an Advanced Placement course in a subject. Some indication of the relationship to be expected between total high school enrollment and the enrollment in an Advanced Placement Chemistry class is given by two examples: DeVillbiss High School (Toledo) has had since 1959-60, an Advanced Placement Chemistry class of 16-17 students drawn from a high school enrollment of approximately 2900. (As far as we are aware, this was the only formal Advanced Placement Chemistry course in northwest Ohio until the 1961-1962 school year). A neighboring high school has had an advanced chemistry program for groups of six to ten students formed from a high school enrollment of approximately 1200. In both cases, the teachers felt that the numbers involved were close to the maximum qualified to participate.

These percentages of the total enrollment (0.6 - 0.8%) seem to be of the same order of magnitude as those reported informally by chemistry teachers from public high schools at Advanced Placement Conferences. In 1960-61, there were over 50 high schools within 30 miles of Bowling Green, excluding the Toledo city high schools. Of these, 30 had enrollments of less than 400 and only five had enrollments of over 1000. On this basis, the earlier estimate that in any one year most northwest Ohio high schools might expect to have one to three students qualified to do Advanced Placement work in chemistry appears reasonable.

With the background that has been described, a cooperative program involving students from a number of high schools seemed to be a logical approach to the problem of providing Advanced Placement work in chemistry for northwest Ohio high school students. The Chemistry Department of Bowling Green State University had had several years experience in teaching its rigorous beginning course. All of the lecturing was concentrated on one night of the week and all of the laboratory work on another night in university branches. Plans were made to set up a similar section of the course (with the laboratory work on Saturday morning) on the Bowling Green campus during the 1961-62 academic year. It was open to selected high school students as an Advanced Placement course. It was also determined that Dr. John Baxter's *Modern Chemistry* lectures, which were to be presented by the Midwest Program on Airborne Television Instruction, would constitute a satisfactory equivalent to the on-campus lectures over the year, although the week-by-week coverage of topics was not the same. Since the utilization of centrally televised lectures of this sort seemed to offer important possibilities for future development, it was planned to have the maximum number of students follow the televised lectures.

At least one public school system has operated on a cooperative Advanced Placement program in chemistry. In Alton, Illinois, an Advanced Placement Chemistry course is taught at one high school for students of that school and two others. Many of the programs described in *Advanced Standing* involved students from more than one high school, and some of them included laboratory courses. However, the program described in this report appears to be the first in which a college or university has given students from a number of high schools over a wide rural area the full content of a college-level science course, including laboratory work.

## SELECTION OF PARTICIPANTS

During the second week of September, 1961, letters were sent to the high school principals and chemistry teachers of about 120 schools, and to the superintendents and executive heads of the systems involved. This included all high schools within 50 miles of Bowling Green and a few beyond that distance with good highway connections or a known interest in the Midwest Program on Airborne Television Instruction. The proposed cooperative Advanced Placement program was described briefly and schools were asked to send students having certain qualifications who were interested in applying for the program to Bowling Green on September 16th for tests, interviews, and more detailed information.

The qualifications desired were listed as:

(1) Junior or senior standing.
(2) B+ or better high school record.
(3) The completion of at least two years of high school mathematics.
(4) The completion of a year of high school chemistry except for seniors who had completed high school physics and who would be taking chemistry concurrently with their participation in the program.

However, it was stated that students who did not exactly meet the designated requirements would be considered if they were qualified in general for the program. Principals, chemistry teachers, and parents were also invited to attend the September 16 meeting.

Although less than a week had elapsed since the announcements of the program had been sent out, 46 students from 19 high schools appeared for the tests and interviews, together with about a dozen adults. Three schools each sent five students, two sent four, one sent three, seven each sent two, and six each sent one. Each applicant was asked to fill out a questionnaire. The questionnaire asked for information about their past and current high school programs, their vocational plans, and their hobbies. On the second page, each applicant was asked to write a brief account (only five minutes were allowed) of any important scientific discovery which had been made during the past year. It was hoped that this would not only show how well the student could express himself, but that it would also give an indication of his interest in science outside the classroom.

All of the students who had completed high school chemistry were given the same two tests: (1) Part II of Form 1959 of the American Chemical Society-National Science Teachers Association Cooperative High School Chemistry Test, and (2) a test prepared at Bowling Green State University and identified as BGSU Chemistry Test Form 1961. Students who had not completed high school chemistry were given two of the following three tests: (1) the Series CA-2 Form M Chemistry Aptitude Test of the Iowa Placement Examinations, (2) a Test of Science Reasoning and Understanding, Natural Sciences, Form C or D, and (3) the BGSU Chemistry Test.

The ACS-NSTA Cooperative High School Chemistry Test is one of a well known series sponsored by the Examinations Committee of the Division of Chemical Education of the American Chemical Society. Each of the two parts of the Form 1959 Cooperative High School Chemistry Test contains 50 multiple choice questions and is intended to be completed in 40 minutes. The questions are of the five-choice type and the score is calculated as R—W/4, where R is the number right and W is the number wrong. National norms for various groups of students are available for the separate parts of the test and for the test as a whole. Part II was used because it includes several questions based on the interpretation of a graph.

The BGSU Chemistry Test was developed to assist in selecting students for the National Science Foundation Summer Programs in Chemistry for High School Students which have been conducted at the university, and for use in selecting students for an accelerated general chemistry course. It is intended to be a difficult test, and has been given to selected, rather than to "normal" groups of students. The questions are multiple choice questions of the five-choice type and are scored as R—W/4. The parts of the test are scored separately. Part I contains 24 questions based on arithmetic and algebra. Part II contains 12 questions requiring the algebraic formulation of some simple word problems. (The score on this part of the test is multiplied by two when the total score on the test is calculated.) Part III is composed of 50 questions, about half of which are based on chemistry. These questions are, in general, more difficult than those on the Cooperative High School Chemistry Test. Some of the remaining questions are on elementary physics, which a capable student interested in science might know through personal reading. The maximum score on the mathematical parts of the test is 48 and the maximum total score is 98. The total of 86 items is intended to be completed in 60 minutes. Although percentile ranks of the usual sort are not available, experience has indicated that a student who makes a score of 45 usually has the background necessary to participate in the programs for which the test has been used as a criterion.

The Series CA-2 Form M Chemistry Aptitude Test of the Iowa Placement Examinations was published in 1942 by the Bureau of Educational Research and Service, State University of Iowa, Iowa City, Iowa. It contains two sections based on arithmetic and algebra, a section involving the ability to read material of the sort which would be found in a college chemistry textbook, and a section involving the recall of information on chemistry. This test is intended for use by students who have not had high school chemistry.

The Test of Science Reasoning and Understanding was published in 1952 by the American Council on Education. It consists of excerpts from articles on science magazines such as *The Scientific American* and from textbooks, with a series of multiple choice questions following each excerpt.

The Iowa Chemistry Aptitude Test and the Test of Science Reasoning and Understanding are not discussed in as much detail as the other two tests because performance on the tests was a minor factor in selecting participants for the Cooperative Advanced Placement Program who would be taking their first course in high school chemistry concurrently. The BGSU Chemistry Test was given to several of these students to see how they would perform on the science information questions. (They did poorly.) It should be recalled that the BGSU Chemistry Test has mathematical parts which require no knowledge of chemistry and which contribute almost half the maximum total score.

Six members of the chemistry faculty shared in interviewing the applicants. Some of the interviews were conducted with individual students and some with groups of two to four students. Each student was interviewed by two faculty members. An effort was made in the interviews to assess each applicant's interest in the program and to estimate if he or she would be likely to persevere in it if selected.

The information about each applicant was tabulated and one of the following over-all ratings was assigned in each case: (5) very highly qualified; (4) highly qualified; (3) qualified; (2) probably qualified; (1) possibly qualified; (0) not qualified. In assigning the ratings the major emphasis was placed on the test scores, although no numerical formula was used.

It had been intended to limit the program to 20 students. However, by the time the selection of students was made, it was apparent that there was going to be only one teacher in the high school teacher participation option of the program, and funds were diverted from that use to the support of four additional students. It was anticipated that there would probably be some attrition in the group by the beginning of the second semester.

The increase in the size of the group made it possible to invite all but one of the applicants who could watch televised lectures and who was rated as "probably qualified" or higher. It also made it possible to avoid having to choose between students of nearly equal promise from the same school. This group watching the televised lectures contained 14 students. Eight students from the remaining applicants were selected to attend the Tuesday night lecture section on campus. One student in this group dropped out almost immediately, due to a transportation problem and an anticipated schedule conflict, and was replaced by a student from a different high school. Two other students who could not watch the televised lectures were selected to study independently, rather than attend the lectures on campus. Both students selected for this feature of the program had attended National Science Foundation summer programs for high school students, one at Bowling Green State University and one at Ohio University. Both had well qualified chemistry teachers in their high schools and one's father was a chemist.

Of the applicants who could not watch the televised lectures, all but four who scored above the fiftieth percentile on the Cooperative High School Chemistry Test were invited to participate in the program. Two students applied for the program after the September 16 testing and interview day. On the basis of tests and interviews, both appeared qualified and were added to the program, one to watch the televised lectures and the other to attend the on-campus lectures.

Although the announcement of the program sent to schools had not indicated any restriction to those with science-related vocational plans, or to those intending to go to college, only two of all the applicants had no science-related vocational interest, and only one did not indicate a definite interest in going to college. One of the students with no vocational interest in science was invited to participate, but became the earliest drop-out. The student with no expressed interest in going to college, a girl, was rated at "questionably qualified" because she would have been taking chemistry concurrently, had not had physics, and had completed only one year of high school mathematics.

All of the students selected for the program had B+ or better high school records, and several had straight A records. All but one either had completed high school physics or were taking it concurrently. All had completed three years of high school mathematics and most were taking additional mathematics. All of the participants were high school seniors; two of them, who had completed physics as juniors were taking high school chemistry concurrently with their participation in the Advanced Placement program. (Some of the high school juniors who applied for the program would probably have been qualified, but none had completed either high school chemistry or physics.)

## THE COOPERATIVE ADVANCED PLACEMENT PROGRAM

The high school students in the Cooperative Advanced Placement Program covered the subject matter of the courses described in the Bowling Green State University Catalog as Chemistry 101 and the second semester course Chemistry 102. Chemistry 101 has a prerequisite of proficiency equivalent to a year of high school algebra. Chemistry 101-102 is the most rigorous general chemistry sequence offered at Bowling Green State University and meets the requirements for chemistry major and pre-engineering programs, although it is not restricted to science majors.

During the 1961-62 academic year the text for Chemistry 101-102 was the second edition of *Chemistry*, by Sienko and Plane. (McGraw-Hill Book Co., Inc., New York, 1961). The following chapters were covered:

| *Chapter* | *First Semester* | *Chapter* | *Second Semester* |
|---|---|---|---|
| 1 | Methods of Chemistry | 13 | Chemical Equilibrium |
| 2 | Nature of Matter | 17 | Aqueous Solutions |
| 3 | Atoms | 18 | The Alkali Metals |
| 4 | Chemical Bond | 19 | The Alkaline-earth Metal |
| 5 | Stoichiometry | 20 | Transition Elements I |

| *Chapter* | *First Semester* | *Chapter* | *Second Semester* |
|---|---|---|---|
| 6 | Gases | 24 | Group IV Elements |
| 7 | Liquids | 25 | Group V Elements |
| 8 | Solids | 27 | The Halogens |
| 9 | Changes of State | 28 | Organic Chemistry |
| 10 | Solutions | 29 | Nuclear Structure and Radioactivity |
| 12 | Chemical Kinetics | | |
| 14 | Electrochemistry | | |

The laboratory manual used during the first semester and for part of the second was the second edition of *Experimental Chemistry*, by Sienko and Plane (McGraw-Hill Book Co., Inc., New York, 1961). The following experiments were performed:

| | |
|---|---|
| E5 | Multiple Proportions |
| E6 | Heat and Temperature |
| E7 | Determination of Atomic Weight |
| E9 | Stoichiometry |
| E10 | Gases and Absolute Zero |
| E11 | Molar Volume of Oxygen |
| E17 | Solubility and Purification of Potassium Nitrate |
| E19 | Chemical Kinetics |
| E20 | Chemical Equilibrium |
| E26 | Acid-Base Titration |
| E27 | pH |
| E28 | Hydrolysis and Amphoterism |
| E29 | Solubility Product of Cupric Iodate |
| E32 | Quantitative Analysis of a Soluble Sulfate |
| E34 | Preparation of a Complex Iron Salt |

The following additional experiments were done from mimeographed directions:

The Observation of Some Chemical Reactions
Weighing on the Pulp Balance
Molecular Weight of Vapor Density
Molecular Weight by Freezing Point Lowering
Equivalent Weight by Hydrogen Displacement
Preparation of Aniline
Separation of Thorium from Uranium

Nearly all of the experiments in the above groups required quantitative measurements. Four of the experiments were carried out by the students working in pairs; the others were performed by the students individually.

During the second semester, about two thirds of the laboratory time was spent on qualitative analysis. The laboratory manual used was the third edition of *Introduction to Semi-micro Qualitative Analysis,* by C. H. Sorum (Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1960). All of the cations considered in that laboratory manual were included. Of the 13 anions listed, sulfite, borate, chromate, and arsenate were excluded. The work in qualitative analysis included the analyses of eight unknowns.

The students in the Cooperative Advanced Placement Program had 100 minutes of lecture a week, whether they watched the televised lecture or came to the campus for lectures. They spent three and a half to four hours in laboratory work each Saturday morning and had a recitation-discussion period for 50-60 minutes early Saturday afternoon, finishing by 1:30 P. M.

## Scheduling

During the first semester, it was possible to use the Chemistry 101 schedule without alteration in the Cooperative Advanced Placement Program. The students who were watching the televised lectures were perhaps inconvenienced by the fact that the televised lectures were generally somewhat ahead of the on-campus lectures and the laboratory work. Although there was some difference in the order of topics, by the end of the year the coverage was very nearly the same. The televised lectures spent more time on acids, bases, and indicators than the Chemistry 101-102 lectures and less time on qualitative analysis. To compensate for the latter deficiency, about three hours of Saturday laboratory time were used during the second semester for lectures on qualitative analysis.

The emphasis in the Cooperative Advanced Placement Program was on giving the students the best possible college level general chemistry course, rather than on preparing them for the Advanced Placement Examination. Since the Advanced Placement Examination in Chemistry was given in 1962 on May 17, about a week before the end of the university semester, slight alterations were made in the Chemistry 102 schedule for the Advanced Placement students. They were permitted to defer two of the intermediate cation unknowns in order that they might have the experience of analyzing one or two salts for both an anion and a cation before the Advanced Placement Test. Some basic material on organic chemistry and nuclear chemistry was introduced at one of the recitation-discussion periods before the Advanced Placement Test, earlier than it was discussed in Chemistry 101-102.

During the first semester, the students in the Cooperative Advanced Placement Program took the same three hour examinations taken by university students in Chemistry 101. They also took the same course final examination and the same laboratory final examination. During February and March, at the beginning of Chemistry 102, there were extensive absences. As a result, the first hour examination, although the same as given to Chemistry 102 students, was given later. The second hour examination was a special examination containing questions requiring more extensive essay type answers than was usual in Chemistry 101-102. Because of the imminence of the Advanced Placement Examination, no third hour examination was given during the second semester.

The schedule was further complicated at the end of the second semester by the fact that many of the students in the program graduated from high school shortly after the Advanced Placement Examination, and two had graduated before they took the examination. It was desired to have the students take the course and laboratory final examinations at the end of Chemistry 102 as they had at the end of Chemistry 101, so that their performance could be compared with that of regular university students, but it proved impractical to arrange for both. Since the Chemistry 102 course final examination was one of the forms of the American Chemical Society General College Chemistry Examination for which national norms are available, it was arranged to have the Advanced Placement Program students take this examination on campus or in their own schools. Because qualitative analysis was covered on the laboratory final examination, no written measure of their mastery of this part of Chemistry 102 was available for comparison with the work of regular university students.

## Absences, Morale, and Drop-outs

The students in the Cooperative Advanced Placement Program averaged three absences each from the Saturday laboratory and recitation-discussion periods. The two most common causes of absences were college entrance examinations and interscholastic activities such as band competitions. There were few absences due to illness or driving conditions and almost no absences for social and family events. Morale was high throughout the year. There were fewer drop-outs than had been anticipated and students came in without urging during the Christmas vacation and at the end of the year to make up laboratory work.

Four of the 27 students involved as participants dropped out of the program during the first semester. Two were watching the televised lectures. One of these was a student who joined the program late and was deeply involved in extra-curricular school activities, as well as being required to work in a family business. The other had lost his father during his junior year and felt it necessary to drop out in order to get a Saturday job; although he was taking high school chemistry concurrently, he was doing B+ work when he dropped out just before the final examination. One student who had been expected to watch television, but who would have found it necessary to change to an independent study basis, dropped out very early because of a transportation problem and an anticipated schedule conflict. All of these were boys. One girl who was attending lectures on campus dropped out of the program because she and her parents felt that she was trying to do too much and that her regular school work was suffering.

One girl who was watching the televised lectures developed a transportation problem and was rarely able to attend on Saturday. She came at other times for help and persevered with great faithfulness, carrying out most of the laboratory work in her own school. She did not get very far into the second semester's work by the end of the year, but completed the first semester's work with a high B. Another girl who watched the televised lectures discussed dropping out but finally decided to remain in the program.

The second of the boys who was taking high school chemistry concurrently with the Advanced Placement Program should perhaps have been encouraged to drop out of the program. His high school work and his work in the Advanced Placement Course deteriorated during the year. He was involved in a large number of extra-curricular activities in his school and community. His situation was discussed several times with his high school chemistry teacher, but since his interest in the Advanced Placement Course seemed to be maintained, no pressure was put on him to drop out.

### The Chemistry Advanced Placement Examination

The Chemistry Advanced Placement Examination was given to the students in the Cooperative Advanced Placement Program at Bowling Green State University on May 17, 1962. The student registration and examination fees, less the coordinator's and proctor's fees which were waived by the university personnel who administered the examination, were paid by the Ohio Council on Advanced Placement. The examination consisted of two parts, an objective section containing 60 items for which an hour was allowed, and an essay section for which two hours was allowed.

The objective section of the examination is maintained in close security by the College Entrance Examination Board. The exact coverage of this part of the examination is therefore unknown, but students who have taken a recent Chemistry Advanced Placement Examination and an American Chemical Society General Chemistry Examination generally feel that the objective section of the Chemistry Advanced Placement Examination was considerably more difficult than the American Chemical Society General Chemistry Examination.

The essay section of the examination is released each year after the Advanced Placement Examination has been given. The format varies slightly from year to year, but the general form remains the same. The essay part of the examination is divided into several sections, the relative weights of which are indicated. Within each section there is some choice, but it is not possible for a student to completely avoid any type of question. For example, on the 1962 examination Part A (20%) required the student to solve one of two problems each with several steps. Part B (20%) required the student to solve one of two equilibrium problems. Part C (10%) required the student to write equations for five out of eight reactions given. Part C (20%) required essay answers to three of five questions. Part D (30%) required a long essay on one of two topics. Students were advised to spend 30 minutes on Part C and 45 minutes on Part D.

### Performance of the Students

It is believed that the letter grades are comparable to those of regular university students, but they were not computed using the same formula because the Advanced Placement Program students were not given as many short quizzes and did not have the same number of hour examinations in the second semester.

The College Entrance Examination Board suggests that the scores given on the advanced placement examination be interpreted as follows: 5 = High Honors, 4 = Honors, 3 = Creditable, 2 = Passing, 1 = No Credit. (It should be noted, however, that whether or not advanced placement and/or credit is awarded is up to the college which receives the student's scores.)

## DISCUSSION

The accomplishments of the Cooperative Advanced Placement Program in Chemistry can be evaluated in several different ways as far as student performance is concerned. The most important consequence of participation for students will be its effect on their college careers, beginning with whether or not they receive advanced placement, with or without credit. Information on this point is not available for all the participants at the time this report is written. However, it is possible to compare the scores of the participants on the Chemistry Advanced Placement Examination with those of other students who took the same examination, and to compare at least some of their work in Chemistry 101-102 with that of regular university students in the same courses.

A comparison of the scores on the Chemistry Advanced Placement Examination of May, 1962 achieved by the students in the Bowling Green group and by all students who took the test is given in the following table. Comparison of Scores Achieved on the Chemistry Advanced Placement Examination, May, 1962.

| Examination Portion | Group | Percent with score of | | | | |
|---|---|---|---|---|---|---|
| | | 5 | 4 | 3 | 2 | 1 |
| Objective | Entire (N = 1873) | 14 | 30 | 28 | 22 | 6 |
| | BGSU (N = 23) | 17 | 22 | 30 | 13 | 13 |
| Essay | Entire | 4 | 17 | 25 | 38 | 16 |
| | BGSU | 0 | 13 | 17 | 44 | 26 |
| Composite | Entire | 6 | 23 | 29 | 32 | 10 |
| | BGSU | 0 | 17 | 30 | 35 | 17 |

At first glance, this comparison is somewhat disappointing. It should be borne in mind that it is unusual for all of the students who have been in an Advanced Placement class in a high school to take the Advanced Placement Examination. Had the fees for the students not been paid as a part of the study, it is likely that at least two of the students who obtained composite scores of 1 and one of those who obtained a composite score of 2 would not have taken the examination.

In comparing the work of the Cooperative Advanced Placement Program students with that of regular university students in Chemistry 101-102, it was considered that the most significant quantities to use for the comparison were the average of three hour exams given during the first semester, the first semester course final examination score, and the percentile rank on the American Chemical Society Cooperative General Chemistry Examination. The first semester laboratory final examination was eliminated from consideration because a number of the Advanced Placement students had not completed all of the first semester experiments at the time they took the examination.

Using the criteria selected, the work of the participants in the Cooperative Advanced Placement Program was compared with that of several groups. Since the university students in Chemistry 101-102 are asked to meet only a minimum mathematics requirement and many of them have not had high school physics, an effort was made to select a group for matching purposes. The most satisfactory one consisted of those university students who completed Chemistry 102 and who had scored on the American Chemical Society-National Science Teachers Association Cooperative High School Chemistry Test within the same range of percentile ranks as the Advanced Placement students. University students who had repeated either Chemistry 101 or 102 or who did not take both of them in the 1961-62 school year were eliminated. This left a group of 15 students, all of whom had had at least three years of high school mathematics and all but three of whom had had high school physics.

This group is small because many of the better university students who would normally have entered Chemistry 101-102 are now encouraged to enter the accelerated one semester course, Chemistry 103. Although the Chemistry 103 students did not take the same hour examinations as the Chemistry 101 students, they did take the ACS-NSTA Cooperative High School Chemistry Test at the beginning of the course and the ACS Cooperative General Chemistry Examination as their course final examination. A comparison with this group is also included.

The Advanced Placement student who participated irregularly because of transportation problems has been eliminated from the comparison. Because more than one form was involved for all the examinations and because the advanced placement students took the ACS Cooperative General Chemistry Examination individually or in small groups, as convenient during a period of about three weeks, it was considered that no statistical analysis beyond the calculations of means and standard deviations from the mean was warranted.

The performance of the Advanced Placement students in Chemistry 101-102 compared to that of regular university students appears to be better than their performance on the Chemistry Advanced Placement Examination compared to that of all students who took the examination. The major factor responsible for this difference was probably the relatively poor performance of the Advanced Placement students on the essay questions of the Chemistry Advanced Placement Examination. Although the Chemistry 101-102 examinations required short essay-type answers, the student in the Advanced Placement Program did not have as much experience with questions of this type, especially longer ones, as did students from many of the schools. A secondary factor may have been that the organization of Chemistry 102 put more emphasis on qualitative analysis than did this year's Chemistry Advanced Placement Examination. (Experience with qualitative analysis is specified in the Advanced Placement course description.) This comment was made by other Advanced Placement chemistry teachers at the Chemistry Advanced Placement Course.

## The Use of Television

Since two of the four students who received composite scores of 4 on the Chemistry Advanced Placement Examination were viewers of the televised lectures, it has been demonstrated that satisfactory results in an Advanced Placement Program can be obtained this way. However, the distribution of students between the televised and on-campus lecture in terms of their probable ability was too uneven to permit any significant comparison. Subjectively, the students seemed to feel that it was advantageous to attend the lectures on campus.

## The High School Teacher Participation Option

One teacher applied for participation in the program but was obliged to drop out to assist in planning for the acquisition of Title IV equipment. It appears that too great an expenditure of time may have been expected by participating teachers in view of the intangible benefits offered.

## Summary

This study has demonstrated that it is possible to offer a cooperative Advanced Placement course in a laboratory science for well-prepared and interested students who cannot obtain such a course in their own high schools. The use of televised lectures in such a course seems feasible.

One of the most striking observations of the program to the instructors in it was the tremendous capacity of gifted students to learn by themselves. The program was less successful with students of moderate ability, at least as judged by their scores on the Chemistry Advanced Placement Examination. It would appear that such students might profit by the use of more assigned written work, and that a more definite limitation of their extra-curricular activities may be necessary.

Teacher participation and the potential involvement of the cooperating high schools in the program were largely unexplored in the 1961-62 program.

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